APPENDIX H
HERBICIDE FACT SHEETS

2,4-D

HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

I. BASIC INFORMATION

COMMON NAME: 2,4-D

CHEMICAL NAME: 2,4-dichlorophenoxyacetic acid, including, but not limited to:

Acids and Salts

Cas No. 2008-39-1 and 1928-43-4

Esters

Cas No. 25168-26-7

CHEMICAL TYPE: chlorinated phenoxy compound

PESTICIDE CLASSIFICATION: herbicide

REGISTERED USE STATUS: General Use Pesticide. Restricted Use in Washington for Some Locations. Date and Elevation Restrictions for Aerial Applications in Idaho.

FORMULATIONS: Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the 2,4-D formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

RESIDUE ANALYTICAL METHODS: EPA Method 600/4-88-039 515.1; 515.2; 555.

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES: 2,4-D is registered for use in crop and non-crop sites for selective and total weed control. For terrestrial and aquatic uses.

OPERATIONAL DETAILS:

TARGET PLANTS: 2,4-D is used for control of grasses, broadleaf weeds, and woody plants.

MODE OF ACTION: Plant growth regulator.

METHOD OF APPLICATION AND RATES: Aerial and ground broadcast, spot and localized applications. Rates depend on formulation.

SPECIAL PRECAUTIONS:

TIMING OF APPLICATION: Timing is dependent on the target plant.

DRIFT CONTROL: Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

RESTRICTIONS/WARNINGS/LIMITATIONS: Do not apply through any type of irrigation system. Groundwater advisory. Various state use restrictions.

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: The half-life of 2,4-D is from less than one day to several weeks.

ADSORPTION: The K(oc) of 2,4-D is 19.6 to 109.1.

PERSISTENCE AND AGENTS OF DEGRADATION: 2,4-D is can be moderately persistent in the plant and soils. The primary route of degradation is microbial activity.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: 2,4-D degrades to many less toxic chemicals.

WATER:

SOLUBILITY: 3.39×10^{4} mg/l in water (pH 7 at 25° C).

POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER: 2,4-D is moderately persistent with a low soil adsorption coefficient. There is a moderate potential for 2,4-D to leach into groundwater.

AIR:

VOLATILIZATION: 1.4×10^{-7} mm Hg at 25° C.

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: Not known.

IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

MICROORGANISMS:

ACUTE CONTACT TOXICITY: LD_{50} (honey bee contact) >100 µg/bee

OVERALL TOXICITY: Practically Non-Toxic

PLANTS: Contact will injure or kill target and non-target plants.

AQUATIC VERTEBRATES:

ACUTE TOXICITY: LC_{50} (rainbow trout 96-hour) 1.1 - >240 mg/l

ACUTE TOXICITY: LC_{50} (bluegill sunfish 96-hour) 0.9 - >524 mg/l

OVERALL TOXICITY: Highly Toxic - Practically Non-Toxic (Depending on Formulation)

AQUATIC FRESHWATER INVERTEBRATES:

ACUTE TOXICITY: LC_{50} (*Daphnia magna* 48-hour) 5.8 - >184 mg/l

OVERALL TOXICITY: Moderately Toxic - Practically Non-Toxic (Depending on Formulation)

AQUATIC ESTUARINE/MARINE INVERTEBRATES:

ACUTE TOXICITY: LC_{50} (Dungeness crab 96-hour) >10.0 mg/l
ACUTE TOXICITY: LC_{50} (brown shrimp 96-hour) >2.0 mg/l

OVERALL TOXICITY: Moderately Toxic - Slightly Toxic (Depending on Formulation)

TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD_{50} (various birds) 472 - >2000 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (various birds) >1000 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD_{50} (various mammals) >100 - >5000 mg/kg

OVERALL TOXICITY: Moderately Toxic to Practically Non-Toxic (Depending on Formulation)

BIOACCUMULATION POTENTIAL: Low Potential

THREATENED AND ENDANGERED SPECIES: All federally listed terrestrial and aquatic species may be adversely affected if certain formulated products are applied directly or indirectly to the species or habitat.

V. TOXICOLOGICAL DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD_{50} (rat) >50 - >5000 mg/kg

ACUTE DERMAL TOXICITY: LD_{50} (rabbit) >2000 -20,000 mg/kg

PRIMARY SKIN IRRITATION: Rabbit - Slight - Non-Irritant

PRIMARY EYE IRRITATION: Rabbit – Severe Irritant - Slight Irritant

ACUTE INHALATION: LC_{50} (rat) >1.0 - >100.0 mg/l

OVERALL TOXICITY: Category 1 – Highly Toxic to Practically Non-Toxic (Depending on Formulation)

CHRONIC TOXICITY:

CARCINOGENICITY: IARC Group 2B - Possible human carcinogen.

DEVELOPMENTAL/REPRODUCTIVE: Animal studies indicate limited ability to cause birth defects. Evidence suggests adverse reproductive effects at moderate doses.

MUTAGENICITY: Evidence suggests adverse effects on human chromosomes.

HAZARD: The end-use product labels for the 2,4-D formulations vary considerably between the *Caution* and *Danger* signal words due to various effects.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: Nervous system from skin absorption. Dizziness, irritation and coughing from inhalation. Ingestion of large amounts of 2,4-D has caused death within 1 to 2 days. Ingestion of lower doses has resulted in neuromuscular problems. Existing medical conditions may be aggravated by exposure to 2,4-D.

CHRONIC TOXICITY:

REPORTED EFFECTS: Liver, kidney, digestive, muscular and nervous system damage.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: See above.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS: None reported.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: See above.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: Past reports of dioxin contamination. Recent testing has shown 2,4-D manufactured in the U.S. to be relatively free of dioxin. Minor traces found do not have biological significance.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: None reported.

VII. SAFETY PRECAUTIONS

SIGNAL WORD AND DEFINITION:

Most Acid and Salt Formulations:

2,4-D - **DANGER** - CAUSES IRREVERSIBLE EYE DAMAGE. HARMFUL IF SWALLOWED OR ABSORBED THROUGH SKIN. AVOID BREATHING SPRAY MIST. DO NOT GET IN EYES, ON SKIN OR CLOTHING.

Most Esters:

2,4-D - **CAUTION** – HARMFUL IF SWALLOWED, ABSORBED THROUGH THE SKIN OR INHALED. AVOID BREATHING VAPORS AND SPRAY MIST. AVOID CONTACT WITH EYES, SKIN OR CLOTHING.

PROTECTIVE PRECAUTIONS FOR WORKERS: Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks, and protective eyewear where appropriate.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

EYES: Imperative to flush eyes with water for a minimum of 15 minutes. Call physician immediately.

SKIN: Wash all exposed areas with soap and water. Call physician if irritation persists.

INGESTION: Rinse mouth thoroughly with water. Promptly drink a large quantity of milk, egg whites, gelatin or water. Do not induce vomiting. Call physician immediately.

INHALATION: Remove to fresh air. Call a physician if breathing difficulty persists.

HANDLING, STORAGE AND DISPOSAL: Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

EMERGENCY SPILL PROCEDURES AND HAZARDS: Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

VIII. DEFINITIONS

adsorption – the process of attaching to a surface

avian – of, or related to, birds

CAEPA – California Environmental Protection Agency

carcinogenicity – ability to cause cancer

CHEMTREC – Chemical Transportation Emergency Center

dermal – of, or related to, the skin

EC_{50} - median effective concentration during a bioassay

ecotoxicological – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

FIFRA – Federal Insecticide, Fungicide and Rodenticide Act

formulation – the form in which the pesticide is supplied by the manufacturer for use

half-life – the time required for half the amount of a substance to be reduced by natural processes

herbicide – a substance used to destroy plants or to slow down their growth

Hg – chemical symbol for mercury

IARC – International Agency for Research on Cancer

K(oc) – the tendency of a chemical to be adsorbed by soil, expressed as: K(oc) = conc. adsorbed/conc. dissolved/% organic carbon in soil

LC_{50} – the concentration in air, water, or food that will kill approximately 50% of the subjects

LD_{50} – the dose that will kill approximately 50% of the subjects

leach – to dissolve out by the action of water

mg/kg – weight ratio expressed as milligrams per kilogram

mg/l – weight-to-liquid ratio expressed as milligrams per liter

microorganisms – living things too small to be seen without a microscope

mPa – milli-Pascal (unit of pressure)

mutagenicity – ability to cause genetic changes

NFPA – National Fire Protection Association

NIOSH - National Institute for Occupational Safety and Health

NOEL - no observable effect level

non-target – animals or plants other than the ones that the pesticide is intended to kill or control

OSHA - Occupational Safety and Health Administration

Pa – Pascal (unit of pressure)

persistence – tendency of a pesticide to remain to remain in the environment after it is applied

pesticides – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

PPE – personal protective equipment

ppm – weight ratio expressed as parts per million

residual activity – the remaining amount of activity as a pesticide

T&E – Threatened and Endangered Species (from the Endangered Species Act)

µg – micrograms

volatility – the tendency to become a vapor at standard temperatures and pressures

IX. INFORMATION SOURCES

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BASF Corporation, Weedmaster® Herbicide, Specimen Product Label, NVA 97-4-69-0117, 1997

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USDA Forest Service, Pesticide Fact Sheet, 2,4-D, November 1995 http://www.fs.fed.us/foresthealth/pesticide/index.html

Walters, Johanna, California Department of Pesticide Regulation, Environmental Fate of 2,4-Dichlorophenoxyacetic Acid, 1998

X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD_{50} (mg/kg)	Acute Dermal LD_{50} (mg/kg)	Acute Inhalation LC_{50} (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	**DANGER (poison)**	0–50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	**WARNING**	>50–500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	**CAUTION**	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	**NONE**	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals Acute Oral LD_{50} mg/kg)	Avian Acute Oral LD_{50} (mg/kg)	Avian Acute Dietary LC_{50} (mg/kg)	Fish or Aquatic Invertebrates Acute Concentration LC_{50} (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

Disclaimers and Other Legal Information:

Mention of a trademark, vendor, technique, or proprietary product does not imply or constitute an endorsement of the product by the United States Department of Energy - Bonneville Power Administration (USDOE-BPA), its employees, and its contractors, and does not imply or endorse any product to the exclusion of others. In all cases, the user is required by law to follow all pesticide label instructions and restrictions.

This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.

Azafenidin

HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION

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I. BASIC INFORMATION

COMMON NAME: azafenidin

CHEMICAL NAME: 2-[2,4-dichloro-5-(2-propynyloxy)phenyl]-5,6,7,8-tetrahydro-1,2,4-triazolo[4,3-a]pyridin-3(2H)-one

CAS No. 68049-83-2

CHEMICAL TYPE*:* triazolone class of herbicides

PESTICIDE CLASSIFICATION*:* selective pre- and postemergent herbicide for broad leaf weeds and grasses.

REGISTERED USE STATUS: "Registration Pending."

FORMULATIONS: Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the azafenidin formulation are not classified by EPA as inert ingredients of toxicological concern to humans or the environment.

The contents of the azafenidin formulation is listed below:

Azafenidin	80 %
Inert	20 %

RESIDUE ANALYTICAL METHODS:

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES: Azafenidin as Milestone™ is registered for use in non-agricultural and agricultural areas for the control of selective broadleaf weeds and grasses and as a total vegetation management tool for bareground treatment. For terrestrial use only.

OPERATIONAL DETAILS:

TARGET PLANTS: Azafenidin is a selective pre- and post-emergent herbicide for control of broadleaf weeds and grasses, including, but not limited to the following: bluegrass, bermudagrass, crabgrass, chickweed, knotweed, milkweed, nettle, nutsedges, ragweed, and Russian thistle.

MODE OF ACTION: Inhibits the porphyrin biosynthetic pathway at a site that causes the accumulation of a photodynamic porphyrin intermediate, protoporphyrin IX, resulting in cell membrane disruption.

METHOD OF APPLICATION AND RATES: Pre- or post-treatment by a variety of spray application methods, with application rates of 8 to 16 ounces of active ingredient per acre.

SPECIAL PRECAUTIONS:

TIMING OF APPLICATION: Approximately one-half inch of rain is necessary for activation. The Milestone formulation is applied any time but is most effective for pre-emergent treatment. The timing will depend on the target plants.

DRIFT CONTROL: Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

Restrictions/Warnings/Limitations: Do not apply directly to water or areas where surface water is present, or to intertidal areas below the mean high water mark. May harm non-target plants.

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: The half-life of azafenidin is 4 to 129 days.

ADSORPTION: The K(oc) of azafenidin is 186 to 579 depending on soil pH and soil types.

PERSISTENCE AND AGENTS OF DEGRADATION: Not known.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: Not known.

WATER:

SOLUBILITY: 18 mg/kg in water.

POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER: The product has low potential to leach into surface and ground water due to low solubility, high K(oc) and relatively rapid field and soil dissipation.

AIR:

VOLATILIZATION: 2.1×10^{-10} mm Hg at 25° C

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: Not known.

IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

MICROORGANISMS:

ACUTE ORAL TOXICITY: LD_{50} (honey bee 48-hour) >20 µg/bee

ACUTE CONTACT TOXICITY: LD_{50} (honey bee 48-hour) >100 µg/bee

OVERALL TOXICITY: Practically Non-Toxic

PLANTS: Contact will injure or kill target and non-target brush/woody plants.

AQUATIC VERTEBRATES:

ACUTE TOXICITY: LC_{50} (rainbow trout 96-hour) 33 mg/l

ACUTE TOXICITY: LC_{50} (bluegill sunfish 96-hour) 48 mg/l

ACUTE TOXICITY: LC_{50} (sheepshead minnow 96-hour) >25 mg/l

OVERALL TOXICITY: Slightly Toxic

AQUATIC INVERTEBRATES:

ACUTE TOXICITY: LC_{50} (*Daphnia magna* 48-hour) 38 mg/l

OVERALL TOXICITY: Slightly Toxic

TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD_{50} (bobwhite quail) >2250 mg/kg

AVIAN ACUTE ORAL TOXICITY: LD_{50} (mallard duck) >2250 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD_{50} (rat) >5000 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (bobwhite quail) >5620 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (mallard duck) >5620 mg/kg

OVERALL TOXICITY: Practically Non-Toxic

BIOACCUMULATION POTENTIAL: Slight Potential

THREATENED AND ENDANGERED SPECIES: Federally listed plants may be adversely affected if the product is applied directly to the plants.

V. TOXICOLOGICAL DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD_{50} (rat) >5000 mg/kg

LD_{50} (rat) >5000 mg/kg (Milestone™)

ACUTE DERMAL TOXICITY: LD_{50} (rabbit) >2000 mg/kg

LD_{50} (rabbit) >5000 mg/kg (Milestone™)

PRIMARY SKIN IRRITATION: Rabbit - Not an Irritant (Technical and Milestone™)

PRIMARY EYE IRRITATION: Rabbit – Not an Irritant (Technical and Milestone™)

ACUTE INHALATION: LC_{50} (rat) >5.3 mg/l

LC_{50} (rat) >5.5 mg/l (Milestone™)

OVERALL TOXICITY: Awaiting final registration by EPA.

CHRONIC TOXICITY:

CARCINOGENICITY: Not listed or classified by EPA or CAEPA as a carcinogen.

DEVELOPMENTAL/REPRODUCTIVE: No effects reported.

MUTAGENICITY: No effects reported.

HAZARD: Awaiting final registration by EPA.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: Ingestion may cause liver toxicity and anemia.

CHRONIC TOXICITY:

REPORTED EFFECTS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS: Information not available.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: Mild, temporary skin and eye irritation.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: None reported.

VII. SAFETY PRECAUTIONS

SIGNAL WORD AND DEFINITION:

AZAFENIDIN **- CAUTION** – CAUSES MODERATE EYE IRRITATION. AVOID CONTACT WITH EYES OR CLOTHING. WASH THOROUGHLY WITH SOAP AND WATER AFTER HANDLING.

PROTECTIVE PRECAUTIONS FOR WORKERS: None.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

EYES: Flush eyes with water; call physician if irritation persists.

SKIN: Wash all exposed areas with soap and water.

INGESTION: None.

INHALATION: None.

HANDLING, STORAGE AND DISPOSAL: Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

EMERGENCY SPILL PROCEDURES AND HAZARDS: Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food or feed by storage or disposal.

VIII. DEFINITIONS

adsorption – the process of attaching to a surface

avian – of, or related to, birds

CAEPA – California Environmental Protection Agency

carcinogenicity – ability to cause cancer

CHEMTREC – Chemical Transportation Emergency Center

dermal – of, or related to, the skin

EC_{50} - median effective concentration during a bioassay

ecotoxicological – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

FIFRA – Federal Insecticide, Fungicide and Rodenticide Act

formulation – the form in which the pesticide is supplied by the manufacturer for use

half-life – the time required for half the amount of a substance to be reduced by natural processes

herbicide – a substance used to destroy plants or to slow down their growth

Hg – chemical symbol for mercury

IARC – International Agency for Research on Cancer

K(oc) – the tendency of a chemical to be adsorbed by soil, expressed as: K(oc) = conc. adsorbed/conc. dissolved/% organic carbon in soil

LC_{50} – the concentration in air, water, or food that will kill approximately 50% of the subjects

LD_{50} – the dose that will kill approximately 50% of the subjects

leach – to dissolve out by the action of water

mg/kg – weight ratio expressed as milligrams per kilogram
mg/l – weight-to-liquid ratio expressed as milligrams per liter
microorganisms – living things too small to be seen without a microscope
mPa – milli-Pascal (unit of pressure)
mutagenicity – ability to cause genetic changes
NFPA – National Fire Protection Association
NIOSH - National Institute for Occupational Safety and Health
NOEL - no observable effect level
non-target – animals or plants other than the ones that the pesticide is intended to kill or control
OSHA - Occupational Safety and Health Administration
Pa – Pascal (unit of pressure)
persistence – tendency of a pesticide to remain to remain in the environment after it is applied
pesticides – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA
PPE – personal protective equipment
ppm – weight ratio expressed as parts per million
residual activity – the remaining amount of activity as a pesticide
T&E – Threatened and Endangered Species (from the Endangered Species Act)
µg – micrograms
volatility – the tendency to become a vapor at standard temperatures and pressures

IX. INFORMATION SOURCES

Du Pont Agricultural Products, Milestone® Herbicide, Material Safety Data Sheet M0000386, January 22, 1998

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Spray Drift Task Force, A Summary of Ground Application Studies, 1997 http://www.agdrift.com/publications/Body.htm

X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD_{50} (mg/kg)	Acute Dermal LD_{50} (mg/kg)	Acute Inhalation LC_{50} (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	**DANGER (poison)**	0–50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	**WARNING**	>50–500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	**CAUTION**	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	**NONE**	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD_{50} mg/kg)	Acute Oral LD_{50} (mg/kg)	Acute Dietary LC_{50} (mg/kg)	Acute Concentration LC_{50} (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

Disclaimers and Other Legal Information:

Mention of a trademark, vendor, technique, or proprietary product does not imply or constitute an endorsement of the product by the United States Department of Energy - Bonneville Power Administration (USDOE-BPA), its employees, and its contractors, and does not imply or endorse any product to the exclusion of others. In all cases, the user is required by law to follow all pesticide label instructions and restrictions.

This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.

Bromacil

HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

I. BASIC INFORMATION

COMMON NAME: bromacil*

CHEMICAL NAME: 5-bromo-3-sec-butyl-6-methyluracil, CAS No. 314-40-9
5-bromo-3-sec-butyl-6-methyluracil, lithium salt, CAS No. 53404-19-6

* According to EPA, bromacil and bromacil lithium salt are toxicologically similar. This Fact Sheet applies to both active ingredients.

CHEMICAL TYPE: uracil class of herbicide

PESTICIDE CLASSIFICATION: systemic, broad-spectrum herbicide to controls weeds and brush

REGISTERED USE STATUS: General Use Pesticide. Restricted Use Pesticide in Washington.

FORMULATIONS: Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the dicamba formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the bromacil formulation is listed below:

Hyvar™ X (Wettable Powder)

Bromacil	80 %
Inert	20 %

Hyvar™ X-L (Water Soluble Liquid)

Bromacil Lithium Salt	21.9 %
Inert	78.1 %

RESIDUE ANALYTICAL METHODS: EPA METHOD 632

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES: Bromacil as Hyvar™ is registered for use in non-agricultural and agricultural areas for the control of weeds, grasses, and as a total vegetation management tool for bare-ground treatment. For terrestrial use only.

OPERATIONAL DETAILS:

TARGET PLANTS: Bromacil is a non-selective herbicide for annual and perennial weeds and brush, woody plants and, vines.

MODE OF ACTION: Bromacil enters the plant through the root zone and moves throughout the plant inhibiting photosynthesis.

METHOD OF APPLICATION AND RATES: Broadcast, band and basal application at 2 to 12 pounds of formulated product per acre. Aerial application is prohibited.

SPECIAL PRECAUTIONS:

TIMING OF APPLICATION: For woody plants and brush, Bromacil is applied in the spring and summer. Weeds are controlled by applying Bromacil prior to or after emergence. As bromacil must move to the root zone to be effective, adequate soil moisture is necessary.

DRIFT CONTROL: Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

Restrictions/Warnings/Limitations: Do not enter or allow others to enter the treated area until sprays have dried. Not for use in recreation or residential areas. Do not apply through any type of irrigation system. Do not apply more than 12 pounds/acre/year for any treated site. Do not apply when ground is frozen. Do not apply directly to water or areas where surface water is present, or to intertidal areas below the mean high water mark. Do not apply to irrigation banks or other ditch banks. Do not graze animals in treated areas. Will harm non-target plants.

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: The half-life of bromacil is 275 days.

ADSORPTION: The K(oc) of bromacil is 32.

PERSISTENCE AND AGENTS OF DEGRADATION: Bromacil is persistent with no major (>10%) degradates.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: The primary metabolites of bromacil are carbon dioxide, 5-bromo-6-methyluracil, 5-bromo-3-(alpha-hydroxymethylpropyl)-6-methyluracil, 5-bromo-3-sec-butyl-6-hydroxymethyluracil, 5-bromo-3-(2-hydroxy-1-methylpropyl)-6-methyluracil, and 3-sec-butyl-6-methyluracil. These metabolites are not of toxicological concern to EPA.

WATER:

SOLUBILITY: 700 mg/kg in water.

POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER: Bromacil is persistent and highly mobile. Bromacil is known to leach into ground water and has high potential to enter surface waters.

AIR:

VOLATILIZATION: Very low.

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: Not known.

IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

MICROORGANISMS:

ACUTE ORAL TOXICITY: LD_{50} (honey bee 48-hour) >1 µg/bee

ACUTE CONTACT TOXICITY: LD_{50} (honey bee 48-hour) >100 ug/bee

OVERALL TOXICITY: Practically Non-Toxic

PLANTS: Contact will injure or kill target and non-target brush/woody plants.

AQUATIC VERTEBRATES:

ACUTE TOXICITY: LC_{50} (rainbow trout 96-hour) 36 mg/l

ACUTE TOXICITY: LC_{50} (bluegill sunfish 96-hour) 127 mg/l

OVERALL TOXICITY: Slightly Toxic

AQUATIC FRESHWATER INVERTEBRATES:

ACUTE TOXICITY: EC_{50} (*Daphnia magna* 48-hour) 121 mg/l

OVERALL TOXICITY: Practically Non-Toxic

AQUATIC ESTUARINE/MARINE INVERTEBRATES:

ACUTE TOXICITY: LC_{50} (Eastern oyster larvae 48-hour) 130 mg/l

ACUTE TOXICITY: LC_{50} (mysid 48-hour) 12.9 mg/l

ACUTE TOXICITY: LC_{50} (sheepshead minnow 48-hour) 1620 mg/l

OVERALL TOXICITY: Practically Non-Toxic

TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD_{50} (bobwhite quail) >2250 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD_{50} (rat) 3998 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (bobwhite quail) >10,000 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (mallard duck) >10,000 mg/kg

OVERALL TOXICITY: Practically Non-Toxic

BIOACCUMULATION POTENTIAL: Low potential

THREATENED AND ENDANGERED SPECIES: Federally listed plants may be adversely affected if the product is applied directly to the plants.

V. TOXICOLOGICAL DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD_{50} (rat) 5126 mg/kg

ACUTE DERMAL TOXICITY: LD_{50} (rabbit) >5000 mg/kg

PRIMARY SKIN IRRITATION: Rabbit - Not an Irritant

PRIMARY EYE IRRITATION: Rabbit – Slight Irritant

ACUTE INHALATION: LC_{50} (rat) >14.4 mg/l

OVERALL TOXICITY: Category III – Caution

CHRONIC TOXICITY:

CARCINOGENICITY: Classified by EPA as Group C - possible human carcinogen.

DEVELOPMENTAL/REPRODUCTIVE: No effects reported.

MUTAGENICITY: Not a mutagenic.

HAZARD: The end-use product label for Hyvar™ carries the *Caution* signal word due to eye irritation, potential exposure to mixers/applicators, and PPE requirements.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: Low Risk.

CHRONIC TOXICITY:

REPORTED EFFECTS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS: Information not available.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: Mild, temporary skin and eye irritation.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: None reported.

VII. SAFETY PRECAUTIONS

SIGNAL WORD AND DEFINITION:

BROMACIL **- CAUTION** – HARMFUL IF SWALLOWED. CAUSES MODERATE EYE IRRITATION. AVOID CONTACT WITH EYES OR CLOTHING

PROTECTIVE PRECAUTIONS FOR WORKERS: Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks, and waterproof gloves.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

EYES: Flush eyes with water; call physician if irritation persists.

SKIN: Wash all exposed areas with soap and water; call physician if irritation persists.

INGESTION: Induce vomiting and call physician or Poison Control Center.

INHALATION: None.

HANDLING, STORAGE AND DISPOSAL: Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly. Liquid formulation is combustible. Do not use or store near heat or open flame. Keep container closed when not in use.

EMERGENCY SPILL PROCEDURES AND HAZARDS: Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food or feed by storage or disposal.

VIII. DEFINITIONS

adsorption – the process of attaching to a surface

avian – of, or related to, birds

CAEPA – California Environmental Protection Agency

carcinogenicity – ability to cause cancer

CHEMTREC – Chemical Transportation Emergency Center

dermal – of, or related to, the skin

EC_{50} - median effective concentration during a bioassay

ecotoxicological – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

FIFRA – Federal Insecticide, Fungicide and Rodenticide Act

formulation – the form in which the pesticide is supplied by the manufacturer for use

half-life – the time required for half the amount of a substance to be reduced by natural processes

herbicide – a substance used to destroy plants or to slow down their growth

Hg – chemical symbol for mercury

IARC – International Agency for Research on Cancer

K(oc) – the tendency of a chemical to be adsorbed by soil, expressed as: K(oc) = conc. adsorbed/conc. dissolved/% organic carbon in soil

LC_{50} – the concentration in air, water, or food that will kill approximately 50% of the subjects

LD_{50} – the dose that will kill approximately 50% of the subjects

leach – to dissolve out by the action of water

mg/kg – weight ratio expressed as milligrams per kilogram

mg/l – weight-to-liquid ratio expressed as milligrams per liter

microorganisms – living things too small to be seen without a microscope

mPa – milli-Pascal (unit of pressure)

mutagenicity – ability to cause genetic changes

NFPA – National Fire Protection Association

NIOSH - National Institute for Occupational Safety and Health

NOEL - no observable effect level

non-target – animals or plants other than the ones that the pesticide is intended to kill or control

OSHA - Occupational Safety and Health Administration

Pa – Pascal (unit of pressure)

persistence – tendency of a pesticide to remain to remain in the environment after it is applied

pesticides – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

PPE – personal protective equipment

ppm – weight ratio expressed as parts per million

residual activity – the remaining amount of activity as a pesticide

T&E – Threatened and Endangered Species (from the Endangered Species Act)

µg – micrograms

volatility – the tendency to become a vapor at standard temperatures and pressures

IX. INFORMATION SOURCES

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http://www.epa.gov/oppsrrd1/REDs/

X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD_{50} (mg/kg)	Acute Dermal LD_{50} (mg/kg)	Acute Inhalation LC_{50} (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	**DANGER (poison)**	0–50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	**WARNING**	>50–500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	**CAUTION**	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	**NONE**	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals Acute Oral LD_{50} mg/kg)	Avian Acute Oral LD_{50} (mg/kg)	Avian Acute Dietary LC_{50} (mg/kg)	Fish or Aquatic Invertebrates Acute Concentration LC_{50} (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

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This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.

Chlorsulfuron

HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION

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I. BASIC INFORMATION

COMMON NAME: chlorsulfuron

CHEMICAL NAME: 2-Chloro-N-[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)aminocarbonyl] benzenesulfonamide

Cas No. 64902-72-3

CHEMICAL TYPE: sulfonylurea herbicide

PESTICIDE CLASSIFICATION: systemic, selective pre- and post-emergent herbicide

REGISTERED USE STATUS: "General Use Pesticide."

FORMULATIONS: Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of these formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the chlorsulfuron formulation are listed below:

Telar® DF

Chlorsulfuron	75 %
Inert	25 %

RESIDUE ANALYTICAL METHODS: EPA METHOD 632

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES: Chlorsulfuron as Telar® is registered for use in non-agricultural areas for the control of weeds, grasses, and as a total vegetation management tool for bareground treatment. For terrestrial use only.

OPERATIONAL DETAILS:

TARGET PLANTS: Chlorsulfuron is a selective herbicide for pre- and post-emergent control of annual, biennial, and perennial broadleaf weeds.

MODE OF ACTION: Chlorsulfuron enters the plant through the root zone and foliage inhibiting the synthesis of key amino acids.

METHOD OF APPLICATION AND RATES: Broadcast and spot spray applications a t1/4 to 3 ounces of formulated product per acre. Ground application only.

SPECIAL PRECAUTIONS:

TIMING OF APPLICATION: Weeds are controlled by applying Chlorsulfuron prior to or after emergence. As chlorsulfuron must move to the root zone to be effective for pre-emergent control, adequate soil moisture is necessary.

DRIFT CONTROL: Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

Restrictions/Warnings/Limitations Do not enter or allow others to enter the treated area until sprays have dried. Do not apply through any type of irrigation system. Do not apply directly to water or areas where surface water is present, or to intertidal areas below the mean high water mark. Do not apply to irrigation banks or other ditch banks. Do not use on lawns. Do not use on walks, driveways, tennis courts, or other impermeable areas. Do not apply to frozen ground. Treated soil should remain undisturbed. Will harm non-target plants.

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: The half-life of chlorsulfuron is 28 to 42 days.

ADSORPTION: The K(oc) of chlorsulfuron is 33.

PERSISTENCE AND AGENTS OF DEGRADATION: Chlorsulfuron is persistent with no major (>10%) degradates.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: Chlorsulfuron degrades to nonphytotoxic, low-molecular-weight compounds.

WATER:

SOLUBILITY: 31,800 mg/l in water (pH 7).

POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER: Chlorsulfuron is moderately persistent and highly mobile and has potential to enter surface waters from runoff. The very low application rate and microbial breakdown suggest that chlorsulfuron has little potential to enter ground water.

AIR:

VOLATILIZATION: Nonvolatile

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: Not known.

IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

MICROORGANISMS:

ACUTE CONTACT TOXICITY: LD_{50} (honey bee contact) >2 µg/bee

OVERALL TOXICITY: Practically Non-Toxic

PLANTS: Contact will injure or kill target and non-target plants.

AQUATIC VERTEBRATES:

ACUTE TOXICITY: LC_{50} (rainbow trout 96-hour) >250 mg/l

ACUTE TOXICITY: LC_{50} (bluegill sunfish 96-hour) >300 mg/l

OVERALL TOXICITY: Practically Non-Toxic

AQUATIC FRESHWATER INVERTEBRATES:

ACUTE TOXICITY: LC_{50} (*Daphnia magna* 48-hour) 370.9 mg/l

OVERALL TOXICITY: Practically Non-Toxic

AQUATIC ESTUARINE/MARINE INVERTEBRATES:

ACUTE TOXICITY: EC_{50} (Eastern oyster larvae 48-hour) 385 mg/l

ACUTE TOXICITY: LC_{50} (sheepshead minnow 96-hour) >980

OVERALL TOXICITY: Practically Non-Toxic

TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD_{50} (bobwhite quail) >5000 mg/kg

AVIAN ACUTE ORAL TOXICITY: LD_{50} (mallard duck) >5000 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (bobwhite quail) >5620 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (mallard duck) >5000 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD_{50} (rat) >5000 mg/kg

OVERALL TOXICITY: Practically Non-Toxic

BIOACCUMULATION POTENTIAL: No Potential

THREATENED AND ENDANGERED SPECIES: Federally listed plants may be adversely affected if the product is applied directly to the plants.

V. TOXICOLOGICAL DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD_{50} (rat) >5000 mg/kg

ACUTE DERMAL TOXICITY: LD_{50} (rabbit) >2000 mg/kg

PRIMARY SKIN IRRITATION: Rabbit - Not an Irritant

PRIMARY EYE IRRITATION: Rabbit – Moderate Irritant

ACUTE INHALATION: LC_{50} (rat) >5.9 mg/l

OVERALL TOXICITY: Category III – Caution

CHRONIC TOXICITY:

CARCINOGENICITY: No effects reported.

DEVELOPMENTAL/REPRODUCTIVE: No effects reported.

MUTAGENICITY: Not a mutagenic.

HAZARD: The end-use product label for Telar® carries the *Caution* signal word due to eye, nose, throat or skin irritation.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: None.

CHRONIC TOXICITY:

REPORTED EFFECTS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS: None reported.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: Mild, temporary skin and eye irritation.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: None reported.

VII. SAFETY PRECAUTIONS

SIGNAL WORD AND DEFINITION:

CHLORSULFURON **- CAUTION** – MAY IRRITATE EYES, NOSE, THROAT OR SKIN

PROTECTIVE PRECAUTIONS FOR WORKERS: Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

EYES: Flush eyes with water; call physician if irritation persists.

SKIN: Wash all exposed areas with soap and water; call physician if irritation persists.

INGESTION: Induce vomiting and call physician or Poison Control Center.

INHALATION: Remove to fresh air.

HANDLING, STORAGE AND DISPOSAL: Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

EMERGENCY SPILL PROCEDURES AND HAZARDS: Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

VIII. DEFINITIONS

adsorption – the process of attaching to a surface

avian – of, or related to, birds

CAEPA – California Environmental Protection Agency

carcinogenicity – ability to cause cancer

CHEMTREC – Chemical Transportation Emergency Center

dermal – of, or related to, the skin

EC_{50} - median effective concentration during a bioassay

ecotoxicological – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

FIFRA – Federal Insecticide, Fungicide and Rodenticide Act

formulation – the form in which the pesticide is supplied by the manufacturer for use

half-life – the time required for half the amount of a substance to be reduced by natural processes

herbicide – a substance used to destroy plants or to slow down their growth

Hg – chemical symbol for mercury

IARC – International Agency for Research on Cancer

K(oc) – the tendency of a chemical to be adsorbed by soil, expressed as: K(oc) = conc. adsorbed/conc. dissolved/% organic carbon in soil

LC_{50} – the concentration in air, water, or food that will kill approximately 50% of the subjects

LD_{50} – the dose that will kill approximately 50% of the subjects
leach – to dissolve out by the action of water
mg/kg – weight ratio expressed as milligrams per kilogram
mg/l – weight-to-liquid ratio expressed as milligrams per liter
microorganisms – living things too small to be seen without a microscope
mPa – milli-Pascal (unit of pressure)
mutagenicity – ability to cause genetic changes
NFPA – National Fire Protection Association
NIOSH - National Institute for Occupational Safety and Health
NOEL - no observable effect level
non-target – animals or plants other than the ones that the pesticide is intended to kill or control
OSHA - Occupational Safety and Health Administration
Pa – Pascal (unit of pressure)
persistence – tendency of a pesticide to remain to remain in the environment after it is applied
pesticides – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA
PPE – personal protective equipment
ppm – weight ratio expressed as parts per million
residual activity – the remaining amount of activity as a pesticide
T&E – Threatened and Endangered Species (from the Endangered Species Act)
µg – micrograms
volatility – the tendency to become a vapor at standard temperatures and pressures

IX. INFORMATION SOURCES

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X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD_{50} (mg/kg)	Acute Dermal LD_{50} (mg/kg)	Acute Inhalation LC_{50} (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	**DANGER (poison)**	0–50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	**WARNING**	>50–500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	**CAUTION**	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	**NONE**	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals Acute Oral LD_{50} mg/kg)	Avian Acute Oral LD_{50} (mg/kg)	Avian Acute Dietary LC_{50} (mg/kg)	Fish or Aquatic Invertebrates Acute Concentration LC_{50} (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

Disclaimers and Other Legal Information:

Mention of a trademark, vendor, technique, or proprietary product does not imply or constitute an endorsement of the product by the United States Department of Energy - Bonneville Power Administration (USDOE-BPA), its employees, and its contractors, and does not imply or endorse any product to the exclusion of others. In all cases, the user is required by law to follow all pesticide label instructions and restrictions.

This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.

Clopyralid

HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

I. BASIC INFORMATION

COMMON NAME: clopyralid

CHEMICAL NAME: 3,6-dichloro-2-pyridinecarboxylic acid, monoethanolamine salt

Cas No. 1702-17-6

CHEMICAL TYPE: pyridine-carboxylic acid

PESTICIDE CLASSIFICATION: herbicide

REGISTERED USE STATUS: "General Use."

FORMULATIONS: Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the clopyralid formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the clopyralid formulation are listed below:

Transline® Specialty Herbicide

Clopyralid	40.9 %
Inert	59.1 %

RESIDUE ANALYTICAL METHODS: Gas/liquid chromatography.

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES: Clopyralid is registered for use in crop and non-crop sites for selective post-emergent weed control. For terrestrial use only.

OPERATIONAL DETAILS:

TARGET PLANTS: Selective, broad leaf weeds.

MODE OF ACTION: Clopyralid is an auxin growth regulator absorbed by the leaves.

METHOD OF APPLICATION AND RATES: Aerial (helicopter only) and ground broadcast, spot and localized applications. One-third to 1 /1/3 pints per acre.

SPECIAL PRECAUTIONS:

TIMING OF APPLICATION: Timing is dependent on emergence of the target plant. As clopyralid must be absorbed through the leaves, timing is limited to emerged plants.

DRIFT CONTROL: Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

Restrictions/Warnings/Limitations: Groundwater advisory. Do not contaminate irrigation ditches or water used for irrigation or domestic purposes. T&E warning for plants.

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: The half-life of clopyralid is 40 days.

ADSORPTION: The K(oc) of clopyralid is 6.

PERSISTENCE AND AGENTS OF DEGRADATION: Clopyralid is moderately persistent in the plant and soils. The primary route of degradation is microbial activity.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: Clopyralid degrades to carbon dioxide and other unidentified products.

WATER:

SOLUBILITY: 300,000 mg/l in water (pH 7 at 25° C).

POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER: Clopyralid is moderately persistent with a very low soil adsorption coefficient. There is a high potential for clopyralid to leach into groundwater when applied over shallow aquifers or to soils having high permeability.

AIR:

VOLATILIZATION: Not volatile.

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: Not known.

IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

MICROORGANISMS:

ACUTE CONTACT TOXICITY: LD_{50} (honey bee contact) >100 µg/bee

OVERALL TOXICITY: Practically Non-Toxic

PLANTS: Contact will injure or kill target and non-target plants.

AQUATIC VERTEBRATES:

ACUTE TOXICITY: LC_{50} (rainbow trout 96-hour) >100 mg/l

ACUTE TOXICITY: LC_{50} (bluegill sunfish 96-hour) >100 mg/l

OVERALL TOXICITY: Practically Non-Toxic

AQUATIC FRESHWATER INVERTEBRATES:

ACUTE TOXICITY: LC_{50} (*Daphnia magna* 48-hour) >100 mg/l

OVERALL TOXICITY: Practically Non-Toxic

AQUATIC ESTUARINE/MARINE INVERTEBRATES:

ACUTE TOXICITY: LC_{50} (fiddler crab 96-hour) No information

ACUTE TOXICITY: LC_{50} (grass shrimp 96-hour) No information

OVERALL TOXICITY: Practically Non-Toxic

TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD_{50} (bobwhite quail) <2000 mg/kg

AVIAN ACUTE ORAL TOXICITY: LD_{50} (mallard duck) <2000 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (bobwhite quail) <5000 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (mallard duck) <5000 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD_{50} (rat) >4000 mg/kg

OVERALL TOXICITY: Slightly Toxic

BIOACCUMULATION POTENTIAL: Little or No Potential

THREATENED AND ENDANGERED SPECIES: Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

V. TOXICOLOGICAL DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD_{50} (rat) >5000 mg/kg

ACUTE DERMAL TOXICITY: LD_{50} (rabbit) >5000 mg/kg

PRIMARY SKIN IRRITATION: Rabbit - Moderate Irritant

PRIMARY EYE IRRITATION: Rabbit – Slight Irritant

ACUTE INHALATION: LC_{50} (rat) >3.0 mg/l

OVERALL TOXICITY: Category III – Slightly Toxic

CHRONIC TOXICITY:

CARCINOGENICITY: No evidence of carcinogenicity in test animals.

DEVELOPMENTAL/REPRODUCTIVE: Some effects at highest dose levels.

MUTAGENICITY: No effects.

HAZARD: The end-use product labels for clopyralid formulations carry the *Caution* signal word due to potential eye, skin and inhalation hazards.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: None reported.

CHRONIC TOXICITY:

REPORTED EFFECTS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: EPA reports no toxicological endpoints of concern..

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS: None reported.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: None reported.

VII. SAFETY PRECAUTIONS

SIGNAL WORD AND DEFINITION:

CLOPYRALID - **CAUTION** – CAUSES EYE INJURY. HARMFUL IF INHALED OR ABSORBED THROUGH THE SKIN

PROTECTIVE PRECAUTIONS FOR WORKERS: Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

EYES: Flush eyes with water.

SKIN: Wash all exposed areas with soap and water; call physician if irritation persists.

INGESTION: Rinse mouth thoroughly with water. Do not induce vomiting. Call physician.

INHALATION: Remove to fresh air. Call a physician if breathing difficulty persists.

HANDLING, STORAGE AND DISPOSAL: Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

EMERGENCY SPILL PROCEDURES AND HAZARDS: Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

VIII. DEFINITIONS

adsorption – the process of attaching to a surface

avian – of, or related to, birds

CAEPA – California Environmental Protection Agency

carcinogenicity – ability to cause cancer

CHEMTREC – Chemical Transportation Emergency Center

dermal – of, or related to, the skin

EC_{50} - median effective concentration during a bioassay

ecotoxicological – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

FIFRA – Federal Insecticide, Fungicide and Rodenticide Act

formulation – the form in which the pesticide is supplied by the manufacturer for use

half-life – the time required for half the amount of a substance to be reduced by natural processes

herbicide – a substance used to destroy plants or to slow down their growth

Hg – chemical symbol for mercury

IARC – International Agency for Research on Cancer

K(oc) – the tendency of a chemical to be adsorbed by soil, expressed as: K(oc) = conc. adsorbed/conc. dissolved/% organic carbon in soil

LC_{50} – the concentration in air, water, or food that will kill approximately 50% of the subjects

LD_{50} – the dose that will kill approximately 50% of the subjects

leach – to dissolve out by the action of water

mg/kg – weight ratio expressed as milligrams per kilogram
mg/l – weight-to-liquid ratio expressed as milligrams per liter
microorganisms – living things too small to be seen without a microscope
mPa – milli-Pascal (unit of pressure)
mutagenicity – ability to cause genetic changes
NFPA – National Fire Protection Association
NIOSH - National Institute for Occupational Safety and Health
NOEL - no observable effect level
non-target – animals or plants other than the ones that the pesticide is intended to kill or control
OSHA - Occupational Safety and Health Administration
Pa – Pascal (unit of pressure)
persistence – tendency of a pesticide to remain to remain in the environment after it is applied
pesticides – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA
PPE – personal protective equipment
ppm – weight ratio expressed as parts per million
residual activity – the remaining amount of activity as a pesticide
T&E – Threatened and Endangered Species (from the Endangered Species Act)
µg – micrograms
volatility – the tendency to become a vapor at standard temperatures and pressures

IX. INFORMATION SOURCES

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Spray Drift Task Force, A Summary of Ground Application Studies, 1997 http://www.agdrift.com/publications/Body.htm

USDA Forest Service, Pesticide Fact Sheet, Clopyralid, November 1995
http://www.fs.fed.us/foresthealth/pesticide/index.html

X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD_{50} (mg/kg)	Acute Dermal LD_{50} (mg/kg)	Acute Inhalation LC_{50} (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	**DANGER (poison)**	0–50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	**WARNING**	>50–500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	**CAUTION**	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	**NONE**	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD_{50} mg/kg)	Acute Oral LD_{50} (mg/kg)	Acute Dietary LC_{50} (mg/kg)	Acute Concentration LC_{50} (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.

Dicamba

HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

I. BASIC INFORMATION

COMMON NAME: dicamba

CHEMICAL NAME: 3,6-dichloro-o-anisic acid

Cas No. 1918-00-9

CHEMICAL TYPE: benzoic acid compound

PESTICIDE CLASSIFICATION: herbicide

REGISTERED USE STATUS: General Use Pesticide. Date and Elevation Restrictions for Aerial Applications in Idaho.

FORMULATIONS: Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the dicamba formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the dicamba formulation are listed below:

Banvel® Herbicide

Dicamba	48.2 %
Inert	51.8 %

Vanquish®

Dicamba	56.8 %
Inert	43.2 %

RESIDUE ANALYTICAL METHODS: Gas/liquid chromatography.

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES: Dicamba is registered for use in crop and non-crop sites for selective pre- and post-emergent weed and brush control. For terrestrial use only.

OPERATIONAL DETAILS:

TARGET PLANTS: Selective, pre- and post-emergent herbicide for control of annual and perennial broadleaf weeds and brush.

MODE OF ACTION: Absorbed by root and shoot tissue causing rapid, abnormal cell growth leading to disruption of the phloem system and normal auxin balance.

METHOD OF APPLICATION AND RATES: Aerial and ground broadcast, spot and localized applications. One-half to four pints per acre.

SPECIAL PRECAUTIONS:

TIMING OF APPLICATION: Timing is dependent on the target plant.

DRIFT CONTROL: Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

Restrictions/Warnings/Limitations: Do not exceed 4 pints per/acre/year. Groundwater advisory. Do not apply within 50 feet of wells or other waters. Do not apply in situations favorable to runoff. Do not apply to impervious surfaces. Do not contaminate irrigation ditches or water used for irrigation or domestic purposes. T&E warning for plants.

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: The half-life of dicamba is 90 days.

ADSORPTION: The K(oc) of dicamba is 2.

PERSISTENCE AND AGENTS OF DEGRADATION: Dicamba is moderately persistent in the plant and soils. The primary route of degradation is microbial activity.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: Dicamba degrades to carbon dioxide and other unidentified products.

WATER:

SOLUBILITY: 400,000 mg/l in water (pH 7 at 25° C).

POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER: Dicamba is moderately persistent with a very low soil adsorption coefficient. There is a high potential for dicamba to leach into groundwater or surface water when applied over shallow aquifers or to soils having high permeability, and to impervious surfaces

AIR:

VOLATILIZATION: Moderately volatile.

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: Not known.

IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

MICROORGANISMS:

ACUTE CONTACT TOXICITY*:* LD_{50} (honey bee contact) >100 µg/bee

OVERALL TOXICITY: Practically Non-Toxic

PLANTS: Contact will injure or kill target and non-target plants.

AQUATIC VERTEBRATES:

ACUTE TOXICITY*:* LC_{50} (rainbow trout 96-hour) >100 mg/l

ACUTE TOXICITY: LC_{50} (bluegill sunfish 96-hour) >100 mg/l

OVERALL TOXICITY: Practically Non-Toxic

AQUATIC FRESHWATER INVERTEBRATES:

ACUTE TOXICITY*:* LC_{50} (*Daphnia magna* 48-hour) 38 mg/l

OVERALL TOXICITY: Slightly Toxic

AQUATIC ESTUARINE/MARINE INVERTEBRATES:

ACUTE TOXICITY*:* LC_{50} (fiddler crab 96-hour) >180 mg/l

ACUTE TOXICITY*:* LC_{50} (grass shrimp 96-hour) >100 mg/l

OVERALL TOXICITY: Practically Non-Toxic

TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD_{50} (mallard duck) >2000 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (bobwhite quail) >10,000 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (mallard duck) >10,000 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD_{50} (rat) >500 mg/kg

OVERALL TOXICITY: Slightly Toxic

BIOACCUMULATION POTENTIAL: Slight Potential

THREATENED AND ENDANGERED SPECIES: Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

V. TOXICOLOGICAL DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD_{50} (rat) 3512 mg/kg

ACUTE DERMAL TOXICITY: LD_{50} (rabbit) >2000 mg/kg

PRIMARY SKIN IRRITATION: Rabbit - Non-Irritant

PRIMARY EYE IRRITATION: Rabbit – Moderate Irritant

ACUTE INHALATION: LC_{50} (rat) >5.3 mg/l

OVERALL TOXICITY: Category III – Slightly Toxic

CHRONIC TOXICITY:

CARCINOGENICITY: No evidence of carcinogenicity in test animals.

DEVELOPMENTAL/REPRODUCTIVE: Some effects at highest dose levels.

MUTAGENICITY: No effects.

HAZARD: The end-use product labels for the dicamba formulation Vanquish® carries the *Caution* signal word due to potential eye and skin hazards.

The end-use product labels for the dicamba formulation Banvel® carries the *Warning* signal word due to potential eye hazards.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: None reported.

CHRONIC TOXICITY:

REPORTED EFFECTS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: EPA reports no toxicological endpoints of concern..

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS: None reported.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: None reported.

VII. SAFETY PRECAUTIONS

SIGNAL WORD AND DEFINITION:

DICAMBA *(Vanquish®)* - **CAUTION** – AVOID CONTACT WITH SKIN, EYES OR CLOTHING. HARMFUL IF SWALLOWED.

DICAMBA (*Banvel®)* - **WARNING** – CAUSES EYE IRRITATION. DO NOT GET IN EYES, ON SKIN OR ON CLOTHING. HARMFUL IF SWALLOWED.

PROTECTIVE PRECAUTIONS FOR WORKERS: Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

EYES: Flush eyes with water.

SKIN: Wash all exposed areas with soap and water, call physician if irritation persists.

INGESTION: Rinse mouth thoroughly with water. Do not induce vomiting. Call physician.

INHALATION: Remove to fresh air. Call a physician if breathing difficulty persists.

HANDLING, STORAGE AND DISPOSAL: Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

EMERGENCY SPILL PROCEDURES AND HAZARDS: Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

VIII. DEFINITIONS

adsorption – the process of attaching to a surface
avian – of, or related to, birds
CAEPA – California Environmental Protection Agency
carcinogenicity – ability to cause cancer

CHEMTREC – Chemical Transportation Emergency Center

dermal – of, or related to, the skin

EC_{50} - median effective concentration during a bioassay

ecotoxicological – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

FIFRA – Federal Insecticide, Fungicide and Rodenticide Act

formulation – the form in which the pesticide is supplied by the manufacturer for use

half-life – the time required for half the amount of a substance to be reduced by natural processes

herbicide – a substance used to destroy plants or to slow down their growth

Hg – chemical symbol for mercury

IARC – International Agency for Research on Cancer

K(oc) – the tendency of a chemical to be adsorbed by soil, expressed as: K(oc) = conc. adsorbed/conc. dissolved/% organic carbon in soil

LC_{50} – the concentration in air, water, or food that will kill approximately 50% of the subjects

LD_{50} – the dose that will kill approximately 50% of the subjects

leach – to dissolve out by the action of water

mg/kg – weight ratio expressed as milligrams per kilogram

mg/l – weight-to-liquid ratio expressed as milligrams per liter

microorganisms – living things too small to be seen without a microscope

mPa – milli-Pascal (unit of pressure)

mutagenicity – ability to cause genetic changes

NFPA – National Fire Protection Association

NIOSH - National Institute for Occupational Safety and Health

NOEL - no observable effect level

non-target – animals or plants other than the ones that the pesticide is intended to kill or control

OSHA - Occupational Safety and Health Administration

Pa – Pascal (unit of pressure)

persistence – tendency of a pesticide to remain to remain in the environment after it is applied

pesticides – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

PPE – personal protective equipment

ppm – weight ratio expressed as parts per million

residual activity – the remaining amount of activity as a pesticide

T&E – Threatened and Endangered Species (from the Endangered Species Act)

µg – micrograms

volatility – the tendency to become a vapor at standard temperatures and pressures

IX. INFORMATION SOURCES

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Novartis Crop Protection, Inc., Vanquish® Herbicide, Material Safety Data Sheet, A-10182 A, February 9, 1999

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USDA Forest Service, Pesticide Fact Sheet, Dicamba, November 1995 http://www.infoventures.com/e-hlth/pestcide/pest-fac.html

X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD_{50} (mg/kg)	Acute Dermal LD_{50} (mg/kg)	Acute Inhalation LC_{50} (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	**DANGER (poison)**	0–50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	**WARNING**	>50–500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	**CAUTION**	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	**NONE**	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals Acute Oral LD_{50} mg/kg)	Avian Acute Oral LD_{50} (mg/kg)	Avian Acute Dietary LC_{50} (mg/kg)	Fish or Aquatic Invertebrates Acute Concentration LC_{50} (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

Disclaimers and Other Legal Information:

This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.

Dichlobenil

HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

I. BASIC INFORMATION

COMMON NAME: dichlobenil

CHEMICAL NAME: 2,6-dichlorobenzonitrile

Cas No. 1194-65-6

CHEMICAL TYPE: benzonitrile

PESTICIDE CLASSIFICATION: herbicide

REGISTERED USE STATUS: "General Use."

FORMULATIONS: Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the dichlobenil formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the dichlobenil formulation are listed below:

Casoron® Herbicide

Dichlobenil	4.0 %
Inert	96.0 %

RESIDUE ANALYTICAL METHODS: Gas chromatography with electron capture.

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES: Dichlobenil is registered for use in crop and non-crop sites for selective and total weed control. For terrestrial use only.

OPERATIONAL DETAILS:

TARGET PLANTS: Dichlobenil is used for control of annual and perennial grasses, broadleaf weeds, and woody plants.

MODE OF ACTION: Acts on growing points and root tips, dichlobenil inhibits germination of actively dividing meristems.

METHOD OF APPLICATION AND RATES: Ground broadcast, spot and localized applications. One hundred to five hundred pounds per acre depending on target species.

SPECIAL PRECAUTIONS:

TIMING OF APPLICATION: Timing is dependent on the target plant.

DRIFT CONTROL: Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

Restrictions/Warnings/Limitations: Do not plant or transplant into treated soil. Do not graze livestock in treated areas.

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: The half-life of dichlobenil is 60 days.

ADSORPTION: The K(oc) of dichlobenil is 400.

PERSISTENCE AND AGENTS OF DEGRADATION: Dichlobenil is moderately persistent in the plant and soils. The primary route of degradation is microbial activity.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: Dichlobenil degrades to 2,6-dichlorobenzamide (BAM) and 2,6-dichlorobenzoic acid. BAM is the primary metabolite produced by soil microbes.

WATER:

SOLUBILITY: 21.2 mg/l in water (pH 7 at 25° C).

POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER: Dichlobenil is moderately persistent with a very high soil adsorption coefficient. There is a moderate potential for dichlobenil to leach into groundwater and a high potential for surface water runoff.

AIR:

VOLATILIZATION: 0.088 Pa at 20° C.

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: Not known.

V. Ecological Toxicity Effects on Non-Target Species

Microorganisms:

Acute Contact Toxicity: LD_{50} (honey bee contact) >120 µg/bee

Overall Toxicity: Practically Non-Toxic

Plants: Contact will injure or kill target and non-target plants.

Aquatic Vertebrates:

Acute Toxicity: LC_{50} (rainbow trout 96-hour) 6.26 mg/l

Acute Toxicity: LC_{50} (bluegill sunfish 96-hour) 6.72 mg/l

Overall Toxicity: Moderately Toxic

Aquatic Freshwater Invertebrates:

Acute Toxicity: LC_{50} (*Daphnia magna* 48-hour) 5.8 mg/l

Overall Toxicity: Moderately Toxic

Aquatic Estuarine/Marine Invertebrates:

Acute Toxicity: LC_{50} (sheepshead minnow 96-hour) >12.7 mg/l

Acute Toxicity: LC_{50} (grass shrimp 96-hour) >1.0 mg/l

Acute Toxicity: LC_{50} (eastern oyster 96-hour) >1.63 mg/l

Overall Toxicity: Moderately Toxic

Terrestrial Animals:

Avian Acute Oral Toxicity: LD_{50} (bobwhite quail) 683 mg/kg

Avian Acute Oral Toxicity: LD_{50} (mallard duck) >2000 mg/kg

Avian Subacute Dietary Toxicity: LC_{50} (bobwhite quail) 5200 mg/kg

Avian Subacute Dietary Toxicity: LC_{50} (mallard duck) >5200 mg/kg

Mammal Acute Oral Toxicity: LD_{50} (rat) 4250 mg/kg

Overall Toxicity: Slightly Toxic

Bioaccumulation Potential: Slight Potential

Threatened and Endangered Species: Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

V. TOXICOLOGICAL DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD_{50} (rat) 4250 mg/kg

ACUTE DERMAL TOXICITY: LD_{50} (rabbit) >2000 mg/kg

PRIMARY SKIN IRRITATION: Rabbit - Non-Irritant

PRIMARY EYE IRRITATION: Rabbit – Non-Irritant

ACUTE INHALATION: LC_{50} (rat) >3.3 mg/l

OVERALL TOXICITY: Category III – Slightly Toxic

CHRONIC TOXICITY:

CARCINOGENICITY: EPA Group C - possible human carcinogen.

DEVELOPMENTAL/REPRODUCTIVE: No adverse effects.

MUTAGENICITY: No adverse effects.

HAZARD: The end-use product labels for the dichlobenil formulation Casoron® carries the *Caution* signal word due to potential eye and skin irritation.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: None reported.

CHRONIC TOXICITY:

REPORTED EFFECTS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS: None reported.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: None reported.

VII. SAFETY PRECAUTIONS

SIGNAL WORD AND DEFINITION:

DICHLOBENIL - **CAUTION** – HARMFUL IF SWALLOWED. AVOID BREATHING DUST. AVOID CONTACT WITH SKIN AND EYES.

PROTECTIVE PRECAUTIONS FOR WORKERS: Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

EYES: Flush eyes with water.

SKIN: Wash all exposed areas with soap and water; call physician if irritation persists.

INGESTION: Rinse mouth thoroughly with water. Do not induce vomiting. Call physician.

INHALATION: Remove to fresh air. Call a physician if breathing difficulty persists.

HANDLING, STORAGE AND DISPOSAL: Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

EMERGENCY SPILL PROCEDURES AND HAZARDS: Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food or feed by storage or disposal.

VIII. DEFINITIONS

adsorption – the process of attaching to a surface

avian – of, or related to, birds

CAEPA – California Environmental Protection Agency

carcinogenicity – ability to cause cancer

CHEMTREC – Chemical Transportation Emergency Center

dermal – of, or related to, the skin

EC_{50} - median effective concentration during a bioassay

ecotoxicological – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

FIFRA – Federal Insecticide, Fungicide and Rodenticide Act

formulation – the form in which the pesticide is supplied by the manufacturer for use

half-life – the time required for half the amount of a substance to be reduced by natural processes

herbicide – a substance used to destroy plants or to slow down their growth

Hg – chemical symbol for mercury

IARC – International Agency for Research on Cancer

K(oc) – the tendency of a chemical to be adsorbed by soil, expressed as: K(oc) = conc. adsorbed/conc. dissolved/% organic carbon in soil

LC_{50} – the concentration in air, water, or food that will kill approximately 50% of the subjects

LD_{50} – the dose that will kill approximately 50% of the subjects

leach – to dissolve out by the action of water

mg/kg – weight ratio expressed as milligrams per kilogram
mg/l – weight-to-liquid ratio expressed as milligrams per liter
microorganisms – living things too small to be seen without a microscope
mPa – milli-Pascal (unit of pressure)
mutagenicity – ability to cause genetic changes
NFPA – National Fire Protection Association
NIOSH - National Institute for Occupational Safety and Health
NOEL - no observable effect level
non-target – animals or plants other than the ones that the pesticide is intended to kill or control
OSHA - Occupational Safety and Health Administration
Pa – Pascal (unit of pressure)
persistence – tendency of a pesticide to remain to remain in the environment after it is applied
pesticides – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA
PPE – personal protective equipment
ppm – weight ratio expressed as parts per million
residual activity – the remaining amount of activity as a pesticide
T&E – Threatened and Endangered Species (from the Endangered Species Act)
µg – micrograms
volatility – the tendency to become a vapor at standard temperatures and pressures

IX. INFORMATION SOURCES

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X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD_{50} (mg/kg)	Acute Dermal LD_{50} (mg/kg)	Acute Inhalation LC_{50} (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	**DANGER (poison)**	0–50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	**WARNING**	>50–500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	**CAUTION**	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	**NONE**	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals Acute Oral LD_{50} mg/kg)	Avian Acute Oral LD_{50} (mg/kg)	Avian Acute Dietary LC_{50} (mg/kg)	Fish or Aquatic Invertebrates Acute Concentration LC_{50} (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.

Diuron

HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

I. BASIC INFORMATION

COMMON NAME: diuron

CHEMICAL NAME: N-(3,4-dichlorophenyl)-N,N-dimethyl urea

Cas No. 330-54-1

CHEMICAL TYPE: substituted urea

PESTICIDE CLASSIFICATION: herbicide

REGISTERED USE STATUS: General Use Pesticide. Restricted Use Pesticide in Washington.

FORMULATIONS: Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the diuron formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the diuron formulation are listed below:

Diuron® 4L Herbicide

Diuron	40.0 %
Inert	60.0 %

Diuron® 80 DF Herbicide

Diuron	80.0 %
Inert	20.0 %

Karmex® DF Herbicide

Diuron	80.0 %
Inert	20.0 %

RESIDUE ANALYTICAL METHODS: EPA Method 632.

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES: Diuron is registered for use in crop and non-crop sites for selective and total weed control. For terrestrial use only.

OPERATIONAL DETAILS:

TARGET PLANTS: Diuron is used for pre- and post-emergent control of annual and perennial grasses and broadleaf weeds.

MODE OF ACTION: Diuron is absorbed through the root system, inhibiting photosynthesis.

METHOD OF APPLICATION AND RATES: Aerial and ground broadcast, spot, and localized applications. Fifteen to forty-eight pounds per acre on non-crop target species.

SPECIAL PRECAUTIONS:

TIMING OF APPLICATION: Timing is dependent on the target plant. Rainfall is required to activate migration to root zone.

DRIFT CONTROL: Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

Restrictions/Warnings/Limitations: Do not plant or transplant into treated soil. Do not graze livestock in treated areas. Do not apply to impervious surfaces.

III. Environmental Effects/Fate

Soil:

Residual Soil Activity: The half-life of diuron is 90 days.

Adsorption: The K(oc) of diuron is 480.

Persistence and Agents of Degradation: Diuron is moderately persistent in the plant and soils. The primary route of degradation is microbial activity.

Metabolites/Degradation Products and Potential Environmental Effects: No information.

Water:

Solubility: 42.0 mg/l in water (pH 7 at 25° C).

Potential for Leaching into Surface and Ground Water: Diuron is moderately persistent, with a very high soil adsorption coefficient. There is a moderate potential for diuron to leach into groundwater and a high potential for surface water runoff.

Air:

Volatilization: 0.41 mPa at 50° C.

Potential for Byproducts from Burning of Treated Vegetation: Not known.

IV. Ecological Toxicity Effects on Non-Target Species

Microorganisms:

Acute Contact Toxicity: LD_{50} (honey bee contact) >100 µg/bee

Overall Toxicity: Practically Non-Toxic

Plants: Contact will injure or kill target and non-target plants.

Aquatic Vertebrates:

Acute Toxicity: LC_{50} (rainbow trout 96-hour) 3.5 mg/l

Acute Toxicity: LC_{50} (bluegill sunfish 96-hour) 42 mg/l

Overall Toxicity: Moderately Toxic

Aquatic Freshwater Invertebrates:

Acute Toxicity: LC_{50} (*Daphnia magna* 48-hour) 1.0 mg/l

Overall Toxicity: Highly Toxic

AQUATIC ESTUARINE/MARINE INVERTEBRATES:

ACUTE TOXICITY: LC_{50} (sheepshead minnow 96-hour)

ACUTE TOXICITY: LC_{50} (grass shrimp 96-hour)

ACUTE TOXICITY: LC_{50} (eastern oyster 96-hour)

OVERALL TOXICITY: Moderately Toxic

TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD_{50} (bobwhite quail) >2000 mg/kg

AVIAN ACUTE ORAL TOXICITY: LD_{50} (mallard duck) >2000 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (bobwhite quail) >1730 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (mallard duck) >1730 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD_{50} (rat) 3400 mg/kg

OVERALL TOXICITY: Slightly Toxic

BIOACCUMULATION POTENTIAL: Slight Potential

THREATENED AND ENDANGERED SPECIES: Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

V. TOXICOLOGICAL DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD_{50} (rat) 3500 mg/kg

ACUTE DERMAL TOXICITY: LD_{50} (rabbit) >2000 mg/kg

PRIMARY SKIN IRRITATION: Rabbit - Mild Irritant

PRIMARY EYE IRRITATION: Rabbit – Mild Irritant

ACUTE INHALATION: LC_{50} (rat) <2.5 mg/l

OVERALL TOXICITY: Category III – Slightly Toxic

CHRONIC TOXICITY:

CARCINOGENICITY: Proposed revised EPA guidelines as a Known/Likely Carcinogen..

DEVELOPMENTAL/REPRODUCTIVE: Teratogenic in mice at high dose levels. Significant decrease in offspring weights at highest dose levels.

MUTAGENICITY: No adverse effects.

HAZARD: The end-use product labels for the diuron formulation Casoron® carries the *Caution* signal word due to potential eye and skin irritation.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: May cause cyanosis, depression, watering eyes, liver enlargement.

CHRONIC TOXICITY:

REPORTED EFFECTS: Skin and eye irritant. Short exposure may cause blood effects, spleen effects, thyroid effects, and other nonspecific effects.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS: Dust from granular product may be an irritant.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: None reported.

VII. SAFETY PRECAUTIONS

SIGNAL WORD AND DEFINITION:

DIURON - **CAUTION** – CAUSES EYE IRRITATION. MAY IRRITATE NOSE, THROAT AND SKIN. AVOID BREATHING DUST OR SPRAY MIST. AVOID CONTACT WITH SKIN, EYES AND CLOTHING.

PROTECTIVE PRECAUTIONS FOR WORKERS: Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

EYES: Flush eyes with water.

SKIN: Wash all exposed areas with soap and water; call physician if irritation persists.

INGESTION: Drink 1 to 2 glasses of water and induce vomiting. Call physician.

INHALATION: Remove to fresh air. Call a physician if breathing difficulty persists.

HANDLING, STORAGE AND DISPOSAL: Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

EMERGENCY SPILL PROCEDURES AND HAZARDS: Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food or feed by storage or disposal.

VIII. DEFINITIONS

adsorption – the process of attaching to a surface

avian – of, or related to, birds

CAEPA – California Environmental Protection Agency

carcinogenicity – ability to cause cancer

CHEMTREC – Chemical Transportation Emergency Center

dermal – of, or related to, the skin

EC_{50} - median effective concentration during a bioassay

ecotoxicological – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

FIFRA – Federal Insecticide, Fungicide and Rodenticide Act

formulation – the form in which the pesticide is supplied by the manufacturer for use

half-life – the time required for half the amount of a substance to be reduced by natural processes

herbicide – a substance used to destroy plants or to slow down their growth

Hg – chemical symbol for mercury

IARC – International Agency for Research on Cancer

K(oc) – the tendency of a chemical to be adsorbed by soil, expressed as: K(oc) = conc. adsorbed/conc. dissolved/% organic carbon in soil

LC_{50} – the concentration in air, water, or food that will kill approximately 50% of the subjects

LD_{50} – the dose that will kill approximately 50% of the subjects

leach – to dissolve out by the action of water

mg/kg – weight ratio expressed as milligrams per kilogram

mg/l – weight-to-liquid ratio expressed as milligrams per liter

microorganisms – living things too small to be seen without a microscope

mPa – milli-Pascal (unit of pressure)

mutagenicity – ability to cause genetic changes

NFPA – National Fire Protection Association

NIOSH - National Institute for Occupational Safety and Health

NOEL - no observable effect level

non-target – animals or plants other than the ones that the pesticide is intended to kill or control

OSHA - Occupational Safety and Health Administration

Pa – Pascal (unit of pressure)

persistence – tendency of a pesticide to remain to remain in the environment after it is applied

pesticides – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

PPE – personal protective equipment

ppm – weight ratio expressed as parts per million

residual activity – the remaining amount of activity as a pesticide

T&E – Threatened and Endangered Species (from the Endangered Species Act)

µg – micrograms

volatility – the tendency to become a vapor at standard temperatures and pressures

IX. INFORMATION SOURCES

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X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD_{50} (mg/kg)	Acute Dermal LD_{50} (mg/kg)	Acute Inhalation LC_{50} (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	**DANGER (poison)**	0–50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	**WARNING**	>50–500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	**CAUTION**	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	**NONE**	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals Acute Oral LD_{50} mg/kg)	Avian Acute Oral LD_{50} (mg/kg)	Avian Acute Dietary LC_{50} (mg/kg)	Fish or Aquatic Invertebrates Acute Concentration LC_{50} (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.

Fosamine Ammonium

HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION

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I. BASIC INFORMATION

COMMON NAME: fosamine ammonium

CHEMICAL NAME: ammonium salt of fosamine; [ethyl hydrogen (aminocarbonyl) phosphonate]

CAS No. 25954-13-6

CHEMICAL TYPE*:* organophosphonate subclass of organophosphate

PESTICIDE CLASSIFICATION*:* herbicidal brush control agent; plant growth regulator

REGISTERED USE STATUS: "General Use."

FORMULATIONS: Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the fosamine ammonium formulation, Krenite™, are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the fosamine ammonium formulation is listed below:

Fosamine ammonium	41.5 %
Inert	58.5 %

RESIDUE ANALYTICAL METHODS: EPA 614, 8141A.

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES: Fosamine ammonium as Krenite™ is registered for use in non-agricultural, uncultivated areas and non-agricultural rights-of-ways for the control of woody plants. For terrestrial use only.

OPERATIONAL DETAILS:

TARGET PLANTS: Fosamine ammonium is a selective, post-emergent herbicide for control of woody/brush and herbaceous plants, including, but not limited to: maple, birch, alder, blackberry, hawthorn, vine maple, ash, and oak.

MODE OF ACTION: Inhibits bud and leaf formation.

METHOD OF APPLICATION AND RATES: Foliar application by open pour, mix/load, high pressure hand wand, backpack, aerial and ultra low-volume equipment at rates of 6 to 24 pounds of active ingredient per acre.

SPECIAL PRECAUTIONS:

TIMING OF APPLICATION: The Krenite formulation is applied any time from full leaf in the spring to first fall coloration.

DRIFT CONTROL: Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions.

Restrictions/Warnings/Limitations: Do not apply directly to water or areas where surface water is present, or to intertidal areas below the mean high water mark. May harm non-target plants. Not for use on crops. Do not plant crops or graze livestock within one year of application. Do not apply through irrigation systems. Do not cut treated brush until stems are dead, or sprouting may occur. Not registered for use in California or Arizona.

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: The half-life of fosamine ammonium is 8 days.

ADSORPTION: The K(oc) of fosamine ammonium is 8 to 150 depending on soil pH and soil types.

PERSISTENCE AND AGENTS OF DEGRADATION: The field half-life of fosamine ammonium is 0.5 to 5 days and is dependent on rapid-microbial mediated dissipation.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: Fosamine ammonium degrades to carbamoylphosphonic acid (CPA), carboxylphosphonic acid (ING-3003), and carbon dioxide. No fate data is available for CPA and ING-3003.

WATER:

SOLUBILITY: Completely miscible in water.

POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER: The product has low potential to leach into surface and ground water due to rapid field and soil dissipation.

AIR:

VOLATILIZATION: 4 x 10^{-6} mm Hg at 25° C.

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: Carbon dioxide may be formed.

IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

MICROORGANISMS:

ACUTE CONTACT TOXICITY: LD_{50} (honey bee 48-hour) >200 µg/bee

OVERALL TOXICITY: Practically Non-Toxic

PLANTS: Contact will injure or kill target and non-target brush/woody plants.

AQUATIC VERTEBRATES:

ACUTE TOXICITY: LC_{50} (rainbow trout 96-hour) 377 mg/l

ACUTE TOXICITY: LC_{50} (bluegill sunfish 96-hour) 590 mg/l

ACUTE TOXICITY: LC_{50} (coho salmon 96-hour) >200 mg/l

OVERALL TOXICITY: Practically Non-Toxic

AQUATIC INVERTEBRATES:

ACUTE TOXICITY: LC_{50} (*Daphnia magna* 48-hour) 1524 mg/l

OVERALL TOXICITY: Practically Non-Toxic

TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD_{50} (bobwhite quail) >5000 mg/kg

AVIAN ACUTE ORAL TOXICITY: LD_{50} (mallard duck) >5000 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD_{50} (rat) >24,400 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (bobwhite quail) >5620 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (mallard duck) >5620 mg/kg

OVERALL TOXICITY: Practically Non-Toxic

BIOACCUMULATION POTENTIAL: Slight Potential

THREATENED AND ENDANGERED SPECIES: Federally listed plants may be adversely affected if the product is applied directly to the plants during budding and leafing until fall coloration.

V. TOXICOLOGICAL DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD_{50} (rat) 24,400 mg/kg

ACUTE DERMAL TOXICITY: LD_{50} (rabbit) >1682 mg/kg

LD_{50} (rabbit) >5000 mg/kg (Krenite™)

PRIMARY SKIN IRRITATION: Rabbit - Low Potential

PRIMARY EYE IRRITATION: Rabbit – Low to Moderate Potential

ACUTE INHALATION: LC_{50} (rat) >56.6 mg/l (male)

LC_{50} (rat) >42 mg/l (female)

OVERALL TOXICITY: Category III – Caution – Causes Moderate Eye Irritation

CHRONIC TOXICITY:

CARCINOGENICITY: Not listed or classified by EPA or CAEPA as a carcinogen.

DEVELOPMENTAL/REPRODUCTIVE: No effects reported.

MUTAGENICITY: Krenite™ was clastogenic both with and without metabolic activation. Chromosome breakage was observed at final concentrations.

HAZARD: The end-use product label for Krenite™ carries the *Caution* signal word due to moderate eye irritation.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: None reported.

CHRONIC TOXICITY:

REPORTED EFFECTS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS: Information not available.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: Mild, temporary skin and eye irritation.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: None reported.

VII. SAFETY PRECAUTIONS

SIGNAL WORD AND DEFINITION:

FOSAMINE AMMONIUM **- CAUTION** – CAUSES MODERATE EYE IRRITATION. AVIOD CONTACT WITH EYES OR CLOTHING. WASH THOROUGHLY WITH SOAP AND WATER AFTER HANDLING.

PROTECTIVE PRECAUTIONS FOR WORKERS: None.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

EYES: Flush eyes with water; call physician if irritation persists.

SKIN: Wash all exposed areas with soap and water.

INGESTION: None.

INHALATION: None.

HANDLING, STORAGE AND DISPOSAL: Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

EMERGENCY SPILL PROCEDURES AND HAZARDS: Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food or feed by storage or disposal.

VIII. DEFINITIONS

adsorption – the process of attaching to a surface

avian – of, or related to, birds

CAEPA – California Environmental Protection Agency

carcinogenicity – ability to cause cancer

CHEMTREC – Chemical Transportation Emergency Center

dermal – of, or related to, the skin

EC_{50} - median effective concentration during a bioassay

ecotoxicological – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

FIFRA – Federal Insecticide, Fungicide and Rodenticide Act

formulation – the form in which the pesticide is supplied by the manufacturer for use

half-life – the time required for half the amount of a substance to be reduced by natural processes

herbicide – a substance used to destroy plants or to slow down their growth

Hg – chemical symbol for mercury

IARC – International Agency for Research on Cancer

K(oc) – the tendency of a chemical to be adsorbed by soil, expressed as: K(oc) = conc. adsorbed/conc. dissolved/% organic carbon in soil

LC_{50} – the concentration in air, water, or food that will kill approximately 50% of the subjects

LD_{50} – the dose that will kill approximately 50% of the subjects

leach – to dissolve out by the action of water

mg/kg – weight ratio expressed as milligrams per kilogram
mg/l – weight-to-liquid ratio expressed as milligrams per liter
microorganisms – living things too small to be seen without a microscope
mPa – milli-Pascal (unit of pressure)
mutagenicity – ability to cause genetic changes
NFPA – National Fire Protection Association
NIOSH - National Institute for Occupational Safety and Health
NOEL - no observable effect level
non-target – animals or plants other than the ones that the pesticide is intended to kill or control
OSHA - Occupational Safety and Health Administration
Pa – Pascal (unit of pressure)
persistence – tendency of a pesticide to remain to remain in the environment after it is applied
pesticides – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA
PPE – personal protective equipment
ppm – weight ratio expressed as parts per million
residual activity – the remaining amount of activity as a pesticide
T&E – Threatened and Endangered Species (from the Endangered Species Act)
µg – micrograms
volatility – the tendency to become a vapor at standard temperatures and pressures

IX. INFORMATION SOURCES

Du Pont Agricultural Products, Krenite® S Brush Control Agent, Specimen Product Label, H-63354, December 9, 1997

Du Pont Agricultural Products, Krenite® S Brush Control Agent, Material Safety Data Sheet M0000022, March 7, 1997

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EPRI, Determination of the Effectiveness of Herbicide Buffer Zones in Protecting Water Quality, EPRI Final Report TR-113160, 1999

Extension Toxicology Network, Toxicology Information Briefs: Bioaccumulation, Revised 1993, http://ace.orst.edu/info/extoxnet/tibs/bioaccum.htm

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USEPA, Office of Pesticide Programs, Reregistration Eligibility Decision, Fosamine ammonium, EPA-738-R-95-004, January 1995, http://www.epa.gov/oppsrrd1/REDs/

USEPA, Office of Pesticide Programs, R.E.D. Facts, Fosamine ammonium, EPA-738-F-95-005, January 1995, http://www.epa.gov/oppsrrd1/REDs/

X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD_{50} (mg/kg)	Acute Dermal LD_{50} (mg/kg)	Acute Inhalation LC_{50} (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	**DANGER (poison)**	0–50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	**WARNING**	>50–500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	**CAUTION**	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	**NONE**	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD_{50} mg/kg)	Acute Oral LD_{50} (mg/kg)	Acute Dietary LC_{50} (mg/kg)	Acute Concentration LC_{50} (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

Disclaimers and Other Legal Information:

Mention of a trademark, vendor, technique, or proprietary product does not imply or constitute an endorsement of the product by the United States Department of Energy - Bonneville Power Administration (USDOE-BPA), its employees, and its contractors, and does not imply or endorse any product to the exclusion of others. In all cases, the user is required by law to follow all pesticide label instructions and restrictions.

This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.

Glyphosate

HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

I. BASIC INFORMATION

COMMON NAME: glyphosate

CHEMICAL NAME: N-(phosphonomethyl)glycine

Cas No. 38641-94-0

CHEMICAL TYPE: phosphanoglycine

PESTICIDE CLASSIFICATION: herbicide

REGISTERED USE STATUS: "General Use."

FORMULATIONS: Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the glyphosate formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

There are many formulations of glyphosate, including:

Accord® Herbicide (Terrestrial/Aquatic Uses)

Glyphosate	41.5 %
Inert	58.5 %

Accord® Site Prep (Terrestrial Uses)

Glyphosate	41 %
Inert	59 %

Glypro® Specialty Herbicide (Terrestrial/Aquatic Uses)

Glyphosate	53.8 %
Inert	46.2 %

Glypro® Plus (Terrestrial Uses)

Glyphosate	41 %
Inert	59 %

Glyphomax® Herbicide (Terrestrial Uses)

Glyphosate	41 %
Inert	59 %

Glyphos® Herbicide (Terrestrial Uses)

Glyphosate	41 %
Inert	59 % (Ethoxylated Tallowamines)

Glypro® Plus (Terrestrial Uses)

Glyphosate	41 %
Inert	59 %

Honcho® Herbicide (Terrestrial Uses)

Glyphosate	41 %
Inert	59 % (Ethoxylated Tallowamines)

Rodeo® Emerged Aquatic Weed and Brush Herbicide (Terrestrial/Aquatic Uses)

Glyphosate	53.8 %
Inert	46.2 %

Roundup Ultra® Herbicide (Terrestrial Uses)

Glyphosate	41 %
Inert	59 %

RESIDUE ANALYTICAL METHODS: EPA Method 547.

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES: Glyphosate is registered for use in crop and non-crop sites, including aquatic sites, for post-emergent weed and woody plant control. For terrestrial and aquatic use.

OPERATIONAL DETAILS:

TARGET PLANTS: Broad spectrum, non-selective for grasses, weeds and woody plants.

MODE OF ACTION: Glyphosate is absorbed by the leaves preventing the plant from producing an essential amino acid.

METHOD OF APPLICATION AND RATES: Aerial and ground broadcast, spot and localized applications. Application rates vary.

SPECIAL PRECAUTIONS:

TIMING OF APPLICATION: Timing is dependent on the target plant. As glyphosate must be absorbed through the leaves, timing is limited to emerged plants.

DRIFT CONTROL: Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

Restrictions/Warnings/Limitations: Non-selective herbicide—apply to target plants only. Unless labeled for aquatic use, do not apply directly to water or to areas where surface water is present. Corrosive to unlined and galvanized steel. T&E warning for plants.

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: The half-life of glyphosate is 47 days.

ADSORPTION: The K(oc) of glyphosate is 24,000.

PERSISTENCE AND AGENTS OF DEGRADATION: Glyphosate is moderately persistent in the plant. The primary route of degradation is microbial activity.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: The primary metabolite of glyphosate is aminomethylphosphonic acid. Environmental effects similar to parent chemical.

WATER:

SOLUBILITY: 11,600 mg/l in water (pH 7 at 25° C).

POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER: Glyphosate is moderately persistent with a very high soil adsorption coefficient. It is not expected to leach or otherwise migrate from the site of application.

AIR:

VOLATILIZATION: Very low.

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: None.

IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

For Glyphosate Formulations Labeled for Terrestrial Uses

MICROORGANISMS:

ACUTE CONTACT TOXICITY: LD_{50} (honey bee contact) >100 µg/bee

OVERALL TOXICITY: Practically Non-Toxic

PLANTS: Contact will injure or kill target and non-target plants.

AQUATIC VERTEBRATES:

ACUTE TOXICITY: LC_{50} (rainbow trout 96-hour) 8.2 mg/l

ACUTE TOXICITY: LC_{50} (bluegill sunfish 96-hour) 5.8 mg/l

ACUTE TOXICITY: LC_{50} (chinook salmon 96-hour) 20 mg/l

ACUTE TOXICITY: LC_{50} (coho salmon 96-hour) 22 mg/l

OVERALL TOXICITY: Moderately Toxic

AQUATIC FRESHWATER INVERTEBRATES:

ACUTE TOXICITY: LC_{50} (*Daphnia magna* 48-hour) 24 mg/l

OVERALL TOXICITY: Slightly Toxic

AQUATIC ESTUARINE/MARINE INVERTEBRATES:

ACUTE TOXICITY: LC_{50} (fiddler crab 96-hour) 934 mg/l

ACUTE TOXICITY: LC_{50} (grass shrimp 96-hour) 281 mg/l

OVERALL TOXICITY: Practically Non-Toxic

TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD_{50} (bobwhite quail) >2000 mg/kg

AVIAN ACUTE ORAL TOXICITY: LD_{50} (mallard duck) >2251 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (bobwhite quail) >6300 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (mallard duck) >6300 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD_{50} (goat) >5000 mg/kg

OVERALL TOXICITY: Practically Non-Toxic

BIOACCUMULATION POTENTIAL: Little or No Potential

For Glyphosate Formulations Labeled for Aquatic/Terrestrial Uses

MICROORGANISMS:

ACUTE CONTACT TOXICITY: LD_{50} (honey bee contact) >100 µg/bee

OVERALL TOXICITY: Practically Non-Toxic

PLANTS: Contact will injure or kill target and non-target plants.

AQUATIC VERTEBRATES:

ACUTE TOXICITY: LC_{50} (rainbow trout 96-hour) >1000 mg/l

ACUTE TOXICITY: LC_{50} (bluegill sunfish 96-hour) >1000 mg/l

OVERALL TOXICITY: Practically Non-Toxic

AQUATIC FRESHWATER INVERTEBRATES:

ACUTE TOXICITY: LC_{50} (*Daphnia magna* 48-hour) 930 mg/l

OVERALL TOXICITY: Practically Non-Toxic

AQUATIC ESTUARINE/MARINE INVERTEBRATES:

ACUTE TOXICITY: LC_{50} (Eastern oyster larvae 48-hour) >10 mg/l

ACUTE TOXICITY : LC_{50} (fiddler crab 96-hour) 934 mg/l

ACUTE TOXICITY: TL_{50} (grass shrimp 96-hour) >281 mg/l

OVERALL TOXICITY: Slightly Toxic

TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD_{50} (bobwhite quail) >2000 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (bobwhite quail) >4640 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (mallard duck) >4640 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD_{50} (goat) >5000 mg/kg

OVERALL TOXICITY: Practically Non-Toxic

BIOACCUMULATION POTENTIAL: Little or No Potential

THREATENED AND ENDANGERED SPECIES: Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

V. TOXICOLOGICAL DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD_{50} (rat) >4320 mg/kg

ACUTE DERMAL TOXICITY: LD_{50} (rabbit) >2000 mg/kg

PRIMARY SKIN IRRITATION: Rabbit - Slight Irritant

PRIMARY EYE IRRITATION: Rabbit – Mild Irritant

ACUTE INHALATION: Not required by EPA.

OVERALL TOXICITY: Category III – Slightly Toxic

CHRONIC TOXICITY:

CARCINOGENICITY: Classified as a Group E chemical: Evidence of non-carcinogenicity for humans.

DEVELOPMENTAL/REPRODUCTIVE: Some effects at highest dose levels.

MUTAGENICITY: No effects.

HAZARD: The end-use product labels for glyphosate formulations without ethoxylated tallowamines carry the *Caution* signal word due to potential eye irritation.

The end-use product labels for glyphosate formulations with ethoxylated tallowamines carry the *Warning* signal word by causing substantial but temporary eye injury.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: Glyphosate formulations will cause reversible eye injury. Will cause hypotension and lung edema if ingested in large quantities.

CHRONIC TOXICITY:

REPORTED EFFECTS: Decreased body weight, decreased food consumption, increased white blood cells, decreased liver weight and increased relative brain weights were observed in test animals.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: EPA reports no toxicological endpoints of concern..

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS: None reported.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: The results of a single exposure (acute) toxicity studies conducted on formulations containing ethoxylated tallowamines indicate that these materials are no more than moderately toxic in rats after ingestion or in rabbits after skin application. The formulation is severely irritating to corrosive to rabbit eyes and can be irritating to rabbit skin.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: None reported.

VII. SAFETY PRECAUTIONS

SIGNAL WORD AND DEFINITION:

GLYPHOSATE - **CAUTION** – CAUSES EYE IRRITATION

GLYPHOSATE WITH ETHOXYLATED TALLOWAMINES - **WARNING** - CAUSES SUBSTANTIAL BUT TEMPORARY EYE INJURY

PROTECTIVE PRECAUTIONS FOR WORKERS: Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks; for the ehtoxylated tallowamine formulations, the user must also wear protective eyewear.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

EYES: Flush eyes with water for 15 minutes and call physician.

SKIN: Wash all exposed areas with soap and water, call physician if irritation persists.

INGESTION: Rinse mouth thoroughly with water. Do not induce vomiting. Call physician.

INHALATION: None normally needed.

HANDLING, STORAGE AND DISPOSAL: Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

EMERGENCY SPILL PROCEDURES AND HAZARDS: Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

VIII. DEFINITIONS

adsorption – the process of attaching to a surface
avian – of, or related to, birds
CAEPA – California Environmental Protection Agency
carcinogenicity – ability to cause cancer
CHEMTREC – Chemical Transportation Emergency Center
dermal – of, or related to, the skin
EC_{50} - median effective concentration during a bioassay
ecotoxicological – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment
FIFRA – Federal Insecticide, Fungicide and Rodenticide Act
formulation – the form in which the pesticide is supplied by the manufacturer for use
half-life – the time required for half the amount of a substance to be reduced by natural processes
herbicide – a substance used to destroy plants or to slow down their growth

Hg – chemical symbol for mercury

IARC – International Agency for Research on Cancer

K(oc) – the tendency of a chemical to be adsorbed by soil, expressed as: K(oc) = conc. adsorbed/conc. dissolved/% organic carbon in soil

LC_{50} – the concentration in air, water, or food that will kill approximately 50% of the subjects

LD_{50} – the dose that will kill approximately 50% of the subjects

leach – to dissolve out by the action of water

mg/kg – weight ratio expressed as milligrams per kilogram

mg/l – weight-to-liquid ratio expressed as milligrams per liter

microorganisms – living things too small to be seen without a microscope

mPa – milli-Pascal (unit of pressure)

mutagenicity – ability to cause genetic changes

NFPA – National Fire Protection Association

NIOSH - National Institute for Occupational Safety and Health

NOEL - no observable effect level

non-target – animals or plants other than the ones that the pesticide is intended to kill or control

OSHA - Occupational Safety and Health Administration

Pa – Pascal (unit of pressure)

persistence – tendency of a pesticide to remain to remain in the environment after it is applied

pesticides – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

PPE – personal protective equipment

ppm – weight ratio expressed as parts per million

residual activity – the remaining amount of activity as a pesticide

T&E – Threatened and Endangered Species (from the Endangered Species Act)

µg – micrograms

volatility – the tendency to become a vapor at standard temperatures and pressures

IX. INFORMATION SOURCES

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X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD_{50} (mg/kg)	Acute Dermal LD_{50} (mg/kg)	Acute Inhalation LC_{50} (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	**DANGER (poison)**	0–50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	**WARNING**	>50–500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	**CAUTION**	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	**NONE**	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD_{50} mg/kg)	Acute Oral LD_{50} (mg/kg)	Acute Dietary LC_{50} (mg/kg)	Acute Concentration LC_{50} (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

Disclaimers and Other Legal Information:

Mention of a trademark, vendor, technique, or proprietary product does not imply or constitute an endorsement of the product by the United States Department of Energy - Bonneville Power Administration (USDOE-BPA), its employees, and its contractors, and does not imply or endorse any product to the exclusion of others. In all cases, the user is required by law to follow all pesticide label instructions and restrictions.

This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.

Halosulfuron-methyl

HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

I. BASIC INFORMATION

COMMON NAME: halosulfuron-methyl

CHEMICAL NAME: Methyl 5-[((4,6-dimethoxy-2pyrimidinyl)amino)carbonylaminosulfonyl]-3-chloro-1-methyl-1H-pyrazole-4-carboxylate

CAS No. 100784-20-1

CHEMICAL TYPE*:* Sulfonyl Urea

PESTICIDE CLASSIFICATION*:* Herbicide

REGISTERED USE STATUS: "General Use."

FORMULATIONS: Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the Manage® formulation are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the halosulfuron-methyl formulation is listed below:

Manage® Turf Herbicide	
Halosulfuron-methyl	75%
Inert	25%

RESIDUE ANALYTICAL METHODS: Analytical Method AG-500B

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES: Manage® is registered for commercial and non-commercial application to established lawns, ornamental turfgrass, and established woody ornamentals in numerous places, including public areas.

OPERATIONAL DETAILS:

TARGET PLANTS: Halosulfuron-methyl is a selective herbicide for post-emergence control of sedges and other weeds in turf.

MODE OF ACTION: Halosulfuron-methyl interferes with acetolactate synthase enzyme, resulting in a rapid cessation of cell division and plant growth in both roots and shoots.

METHOD OF APPLICATION: Halosulfuron-methyl (as Manage®) is applied (ground methods only) to established turf grasses, etc., at an application rate of 0.66 to 1.66 ounces per acre. A second treatment may be necessary.

SPECIAL PRECAUTIONS:

TIMING OF APPLICATION: Halosulfuron-methyl is a post-emergence weed herbicide and is applied after emergence of target weeds.

DRIFT CONTROL: Halosulfuron-methyl is applied mixed with water/surfactant. Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by following label and sprayer instructions.

RESTRICTIONS/WARNINGS/LIMITATIONS: Groundwater advisory. Do not apply within 4 hours of precipitation. Do not apply through any irrigation system. Do not apply by air.

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: The half-life of halosulfuron-methyl is 55 days.

ADSORPTION: The K(oc) of halosulfuron-methyl is 75.

PERSISTENCE AND AGENTS OF DEGRADATION: The manufacturer has not conducted environmental toxicity studies with this product.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: The manufacturer has not conducted environmental toxicity studies with this product.

WATER:

SOLUBILITY: 15 ppm at pH 5; 1630 ppm at pH 7

POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER: The product has high potential to leach into surface and ground water when applied to normal to basic soils (greater than pH 7).

AIR:

VOLATILIZATION: Halosulfuron-methyl is slightly volatile.

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: No information is available.

IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

MICROORGANISMS:

ACUTE CONTACT TOXICITY*:* LD_{50} (honey bee contact) >100 µg/bee

OVERALL TOXICITY: Practically Non-Toxic

PLANTS: Contact will injure or kill target and non-target plants.

AQUATIC VERTEBRATES:

ACUTE TOXICITY*:* LC_{50} (rainbow trout 96-hour) >131 mg/l

ACUTE TOXICITY: LC_{50} (bluegill sunfish 96-hour) >118 mg/l

OVERALL TOXICITY: Practically Non-Toxic

AQUATIC FRESHWATER INVERTEBRATES:

ACUTE TOXICITY*:* LC_{50} (*Daphnia magna* 48-hour) >107 mg/l

OVERALL TOXICITY: Practically Non-Toxic

AQUATIC ESTUARINE/MARINE INVERTEBRATES:

ACUTE TOXICITY*:* EC_{50} (Eastern oyster larvae 48-hour)

ACUTE TOXICITY*:* LC_{50} (grass shrimp 96-hour)

OVERALL TOXICITY:

TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY*:* LD_{50} (bobwhite quail)

AVIAN ACUTE ORAL TOXICITY*:* LD_{50} (mallard duck)

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (bobwhite quail)

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (mallard duck)

MAMMAL ACUTE ORAL TOXICITY: LD_{50} (rat) 1287 mg/kg

OVERALL TOXICITY: Slightly Toxic

BIOACCUMULATION POTENTIAL: Slight Potential

THREATENED AND ENDANGERED SPECIES: Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

V. TOXICOLOGICAL DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD_{50} (rat) >1287 mg/kg

ACUTE DERMAL TOXICITY: LD_{50} (rat) >5000 mg/kg

PRIMARY SKIN IRRITATION: Rabbit – Slightly Irritating

PRIMARY EYE IRRITATION: Rabbit – Moderately Irritating

ACUTE INHALATION: LC_{50} (rat 4 hour) >5.7 mg/l.

OVERALL TOXICITY: Category III – Caution – Slightly Toxic

CHRONIC TOXICITY:

CARCINOGENICITY: No effects.

DEVELOPMENTAL: Slight developmental toxicity.

REPRODUCTIVE: No effects.

MUTAGENICITY: No effects.

HAZARD: EPA has concluded that potential levels of halosulfuron-methyl or metabolites in soil and water do not appear to have significant toxicological effects on humans or animals and presents a negligible risk [63FR29401].

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: In sulfite-sensitive individuals, skin reactions have been reported following dermal exposure.

CHRONIC TOXICITY:

REPORTED EFFECTS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS: Inhalation of both silica gel and kaolin dust may cause coughing, sneezing and nasal irritation.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: There have been no reported effects on workers manufacturing the products.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: None reported.

HEALTH RISK MANAGEMENT PROCEDURES: See Section VII.

VII. SAFETY PRECAUTIONS

SIGNAL WORD AND DEFINITION:

HALOSULFURON-METHYL **- CAUTION** – AVOID CONTACT WITH EYES AND CLOTHING. HARMFUL IF SWALLOWED.

PROTECTIVE PRECAUTIONS FOR WORKERS: Wear eye protection. Wear long-sleeved shirt, long pants, shoes and socks.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

EYES: Flush eyes with water; call physician.

SKIN: Wash all exposed areas with soap and water. Wash all contaminated clothing prior to reuse. Call a physician if irritation develops.

INGESTION: Remove visible particles from mouth and rinse with water. Swallow water to dilute. Immediately transport to a medical care facility.

INHALATION: Remove individual to fresh air. If breathing difficulty occurs, provide CPR assistance and seek immediate medical attention.

HANDLING, STORAGE AND DISPOSAL: Keep dry (below 120° F) and store away from food, feed or other material to be used or consumed by humans or animals. Do not contaminate water. Dispose of only in accordance with local, state, and federal regulations.

EMERGENCY SPILL PROCEDURES AND HAZARDS: Contain and sweep up material of small spills and dispose as waste. Large spills should be reported to CHEMTREC (800-424-9300) for assistance. Prevent runoff. Do not contaminate water, food, or feed by storage or disposal.

VIII. DEFINITIONS

adsorption – the process of attaching to a surface

avian – of, or related to, birds

CAEPA – California Environmental Protection Agency

carcinogenicity – ability to cause cancer

CHEMTREC – Chemical Transportation Emergency Center

dermal – of, or related to, the skin

EC_{50} - median effective concentration during a bioassay

ecotoxicological – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

FIFRA – Federal Insecticide, Fungicide and Rodenticide Act

formulation – the form in which the pesticide is supplied by the manufacturer for use

half-life – the time required for half the amount of a substance to be reduced by natural processes

herbicide – a substance used to destroy plants or to slow down their growth

Hg – chemical symbol for mercury

IARC – International Agency for Research on Cancer

K(oc) – the tendency of a chemical to be adsorbed by soil, expressed as: K(oc) = conc. adsorbed/conc. dissolved/% organic carbon in soil

LC_{50} – the concentration in air, water, or food that will kill approximately 50% of the subjects

LD_{50} – the dose that will kill approximately 50% of the subjects

leach – to dissolve out by the action of water

mg/kg – weight ratio expressed as milligrams per kilogram

mg/l – weight-to-liquid ratio expressed as milligrams per liter

microorganisms – living things too small to be seen without a microscope

mPa – milli-Pascal (unit of pressure)

mutagenicity – ability to cause genetic changes

NFPA – National Fire Protection Association

NIOSH - National Institute for Occupational Safety and Health

NOEL - no observable effect level

non-target – animals or plants other than the ones that the pesticide is intended to kill or control

OSHA - Occupational Safety and Health Administration

Pa – Pascal (unit of pressure)

persistence – tendency of a pesticide to remain to remain in the environment after it is applied

pesticides – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

PPE – personal protective equipment

ppm – weight ratio expressed as parts per million

residual activity – the remaining amount of activity as a pesticide

T&E – Threatened and Endangered Species (from the Endangered Species Act)

µg – micrograms

volatility – the tendency to become a vapor at standard temperatures and pressures

IX. INFORMATION SOURCES

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Spray Drift Task Force, A Summary of Ground Application Studies, 1997 http://www.agdrift.com/publications/Body.htm

USEPA, Notice, Monsanto Company; Pesticide Tolerance Petitions Filing, 63FR29401, May 29, 1998

X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD_{50} (mg/kg)	Acute Dermal LD_{50} (mg/kg)	Acute Inhalation LC_{50} (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	**DANGER (poison)**	0–50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	**WARNING**	>50–500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	**CAUTION**	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	**NONE**	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals (Acute Oral LD_{50} mg/kg)	Avian (Acute Oral LD_{50} mg/kg)	Avian LC_{50} (mg/kg)	Fish or Aquatic Invertebrates LC_{50} (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.

Hexazinone

HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

I. BASIC INFORMATION

COMMON NAME: hexazinone

CHEMICAL NAME: [3-cyclohexyl-6-(dimethylamino)-1-methyl-S-triazine-2,4-(1H,3H)-dione]

Cas No. 51235-04-2

CHEMICAL TYPE: triazine-dione herbicide

PESTICIDE CLASSIFICATION: herbicide

REGISTERED USE STATUS: General Use Pesticide. Restricted Use Pesticide in Washington.

FORMULATIONS: Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the Velpar® formulation are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the hexazinone formulation are listed below:

Velpar® Herbicide (soluble powder)

Hexazinone	90 %
Inert	10 %

Velpar® DF (dispersible granules)

Hexazinone	75 %
Inert	25 %

Velpar® L (water dispersible liquid)

Hexazinone	25 %
Inert	75 % (includes 45% ethanol - CAS 64-17-5)

Velpar® ULW (soluble granules)

Hexazinone	75 %
Inert	25 %

Velpar® ULW DF (soluble granules)

Hexazinone	75 %
Inert	25 %

RESIDUE ANALYTICAL METHODS: EPA Method 633.

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES: Hexazinone as Velpar® is registered for use in agriculture and forestry for selective weed control, and in non-agricultural areas as a non-selective general weed and woody plants control herbicide. For terrestrial use only.

OPERATIONAL DETAILS:

TARGET PLANTS: Broad-spectrum annual, biennial, and perennial weeds including woody plants.

MODE OF ACTION: Hexazinone inhibits photosynthesis.

METHOD OF APPLICATION AND RATES: Broadcast and spot spray applications at 1/4 ounce to 8 ounces of formulated product per acre. Ground or aerial (helicopter only) application. Do not apply more than 8 ounces/acre/year.

SPECIAL PRECAUTIONS:

TIMING OF APPLICATION: Timing is dependent on the target plant. Application may be made at any time the ground is not frozen. As hexazinone must move to the root zone to be effective for pre-emergent control, adequate soil moisture is necessary.

DRIFT CONTROL: Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

Restrictions/Warnings/Limitations: Do not apply through any type of irrigation system. Do not apply to frozen ground. Do not apply 30 to 60 days before grazing, harvest, or feeding. Non-target plants may be adversely effected from drift and run-off.

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: The half-life of hexazinone is 175 days.

ADSORPTION: The K(oc) of hexazinone is 40.

PERSISTENCE AND AGENTS OF DEGRADATION: Hexazinone is persistent and is known to leach into groundwater. Hexazinone is degraded by soil microorganisms and sunlight.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: Hexazinone degrades to carbon dioxide; many degradates have similar or identical characteristics to the parent material.

WATER:

SOLUBILITY: 33,000 mg/l in water (pH 7).

POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER: Hexazinone is persistent and is known to leach into groundwater under favorable soil conditions and high water tables.

AIR:

VOLATILIZATION: 0.03 Pa at 25° C.

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: None.

IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

MICROORGANISMS:

ACUTE CONTACT TOXICITY*:* LD_{50} (honey bee contact) >100 µg/bee

OVERALL TOXICITY: Practically Non-Toxic

PLANTS: Contact will injure or kill target and non-target plants.

AQUATIC VERTEBRATES:

ACUTE TOXICITY*:* LC_{50} (rainbow trout 96-hour) >320 mg/l

ACUTE TOXICITY: LC_{50} (bluegill sunfish 96-hour) >370 mg/l

OVERALL TOXICITY: Practically Non-Toxic

AQUATIC FRESHWATER INVERTEBRATES:

ACUTE TOXICITY: LC_{50} (*Daphnia magna* 48-hour) 151.6 mg/l

OVERALL TOXICITY: Practically Non-Toxic

AQUATIC ESTUARINE/MARINE INVERTEBRATES:

ACUTE TOXICITY: EC_{50} (Eastern oyster larvae 48-hour) >320 mg/l

ACUTE TOXICITY: LC_{50} (grass shrimp 96-hour) >78 mg/l

OVERALL TOXICITY: Slightly Toxic

TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD_{50} (bobwhite quail) >2251 mg/kg

AVIAN ACUTE ORAL TOXICITY: LD_{50} (mallard duck) >2251 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (bobwhite quail) >5000 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (mallard duck) >10,000 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD_{50} (rat) >1100 mg/kg

OVERALL TOXICITY: Slightly Toxic

BIOACCUMULATION POTENTIAL: Slight Potential

THREATENED AND ENDANGERED SPECIES: Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

V. TOXICOLOGICAL DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD_{50} (rat) >1200 mg/kg

ACUTE DERMAL TOXICITY: LD_{50} (rabbit) >5278 mg/kg

PRIMARY SKIN IRRITATION: Rabbit - Slight Irritant

PRIMARY EYE IRRITATION: Rabbit – Severe Irritant

ACUTE INHALATION: LC_{50} (rat) >3.94 mg/l

OVERALL TOXICITY: Category I – Danger

CHRONIC TOXICITY:

CARCINOGENICITY: Classified as a Group D chemical: Not classifiable as a human carcinogen.

DEVELOPMENTAL/REPRODUCTIVE: Some effects at mid- to high dose levels.

MUTAGENICITY: Positive in one study and negative in another. Suggests slight to no mutagenic effects.

HAZARD: The end-use product label for Velpar® carries the *Danger* signal word due to irreversible eye damage.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: Hexazinone formulations will cause irreversible eye damage.

CHRONIC TOXICITY:

REPORTED EFFECTS: Decreased body weight, decreased food consumption, increased white blood cells, decreased liver weight and increased relative brain weights were observed in test animals..

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: EPA reports no toxicological endpoints of concern.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS: None reported.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: Severe eye irritation.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: None reported.

VII. SAFETY PRECAUTIONS

SIGNAL WORD AND DEFINITION:

HEXAZINONE **- DANGER** – CORROSIVE, CAUSES IRREVERSIBLE EYE DAMAGE

PROTECTIVE PRECAUTIONS FOR WORKERS: Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks, and protective eyewear.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

EYES: Flush eyes with water for 15 minutes and call physician.

SKIN: Wash all exposed areas with soap and water; call physician if irritation persists.

INGESTION: Do not induce vomiting. Promptly drink a large quantity of milk, egg whites, gelatin solution, or if these are not available, drink large quantities of water. Avoid alcohol. Call a physician.

INHALATION: Remove to fresh air.

HANDLING, STORAGE AND DISPOSAL: Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

EMERGENCY SPILL PROCEDURES AND HAZARDS: Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

VIII. DEFINITIONS

adsorption – the process of attaching to a surface

avian – of, or related to, birds

CAEPA – California Environmental Protection Agency

carcinogenicity – ability to cause cancer

CHEMTREC – Chemical Transportation Emergency Center

dermal – of, or related to, the skin

EC_{50} - median effective concentration during a bioassay

ecotoxicological – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

FIFRA – Federal Insecticide, Fungicide and Rodenticide Act

formulation – the form in which the pesticide is supplied by the manufacturer for use

half-life – the time required for half the amount of a substance to be reduced by natural processes

herbicide – a substance used to destroy plants or to slow down their growth

Hg – chemical symbol for mercury

IARC – International Agency for Research on Cancer

K(oc) – the tendency of a chemical to be adsorbed by soil, expressed as: K(oc) = conc. adsorbed/conc. dissolved/% organic carbon in soil

LC_{50} – the concentration in air, water, or food that will kill approximately 50% of the subjects

LD_{50} – the dose that will kill approximately 50% of the subjects

leach – to dissolve out by the action of water

mg/kg – weight ratio expressed as milligrams per kilogram

mg/l – weight-to-liquid ratio expressed as milligrams per liter

microorganisms – living things too small to be seen without a microscope

mPa – milli-Pascal (unit of pressure)

mutagenicity – ability to cause genetic changes

NFPA – National Fire Protection Association

NIOSH - National Institute for Occupational Safety and Health

NOEL - no observable effect level

non-target – animals or plants other than the ones that the pesticide is intended to kill or control

OSHA - Occupational Safety and Health Administration

Pa – Pascal (unit of pressure)

persistence – tendency of a pesticide to remain to remain in the environment after it is applied

pesticides – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

PPE – personal protective equipment

ppm – weight ratio expressed as parts per million

residual activity – the remaining amount of activity as a pesticide

T&E – Threatened and Endangered Species (from the Endangered Species Act)

µg – micrograms

volatility – the tendency to become a vapor at standard temperatures and pressures

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X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD_{50} (mg/kg)	Acute Dermal LD_{50} (mg/kg)	Acute Inhalation LC_{50} (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	**DANGER (poison)**	0–50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	**WARNING**	>50–500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	**CAUTION**	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	Moderate irritation at 72 hours
IV (Practically Non-toxic)	**NONE**	>5000	>20,000	>20	no irritation	Moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD_{50} mg/kg)	Acute Oral LD_{50} (mg/kg)	Acute Dietary LC_{50} (mg/kg)	Acute Concentration LC_{50} (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.

Imazapyr

HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

I. BASIC INFORMATION

COMMON NAME: imazapyr

CHEMICAL NAME: 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1-H-imidazol-2-yl]-3-pyridinecarboxylic acid

Cas No. 81334-34-1

CHEMICAL TYPE: imidazolinone

PESTICIDE CLASSIFICATION: herbicide

REGISTERED USE STATUS: "General Use."

FORMULATIONS: Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the imazapyr formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the imazapyr formulation are listed below:

Arsenal® Herbicide

Imazapyr	28.7 %
Inert	71.3 %

Arsenal® Applicators Concentrate Herbicide

Imazapyr	53.1 %
Inert	46.9 %

Arsenal® Railroad Herbicide

Imazapyr	27.6 %
Inert	72.4 %

Chopper® Herbicide

Imazapyr	27.6 %
Inert	72.4 %

RESIDUE ANALYTICAL METHODS: Capillary Electrophoresis Method 2657.

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES: Imazapyr is registered for use in non-crop sites for selective and total weed control. For terrestrial use only.

OPERATIONAL DETAILS:

TARGET PLANTS: Imazapyr is used for pre- and post-emergent control of annual and perennial grasses and broadleaf weeds, brush, vines, and many deciduous trees.

MODE OF ACTION: Imazapyr is absorbed by the leaves and through the root system, disrupting protein synthesis.

METHOD OF APPLICATION AND RATES Aerial and ground broadcast, spot and localized applications at 2 to 6 pints per acre.

SPECIAL PRECAUTIONS:

TIMING OF APPLICATION: Timing is dependent on the target plant.

DRIFT CONTROL: Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

RESTRICTIONS/WARNINGS/LIMITATIONS: Do not use on food or feed crops. Do not treat irrigation ditches or water used for irrigating crops.

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: The half-life of imazapyr is 90 days.

ADSORPTION: The K(oc) of imazapyr is 100.

PERSISTENCE AND AGENTS OF DEGRADATION: Imazapyr is moderately persistent in the plant and soils. The primary route of degradation is microbial activity.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: No information.

WATER:

SOLUBILITY: 1.0 mg/l in water (pH 7 at 25° C).

POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER: Imazapyr is moderately persistent with a moderate soil adsorption coefficient. There is a moderate potential for imazapyr to leach into groundwater and a high potential for surface water runoff.

AIR:

VOLATILIZATION: No information.

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: Not known.

IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

MICROORGANISMS:

ACUTE CONTACT TOXICITY: LD_{50} (honey bee contact) >100 µg/bee

OVERALL TOXICITY: Practically Non-Toxic

PLANTS: Contact will injure or kill target and non-target plants.

AQUATIC VERTEBRATES:

ACUTE TOXICITY: LC_{50} (rainbow trout 96-hour) >100 mg/l

ACUTE TOXICITY: LC_{50} (bluegill sunfish 96-hour) >100 mg/l

OVERALL TOXICITY: Practically Non-Toxic

AQUATIC FRESHWATER INVERTEBRATES:

ACUTE TOXICITY: LC_{50} (*Daphnia magna* 48-hour) >100 mg/l

OVERALL TOXICITY: Practically Non-Toxic

AQUATIC ESTUARINE/MARINE INVERTEBRATES:

ACUTE TOXICITY: LC_{50} (sheepshead minnow 96-hour)

ACUTE TOXICITY: LC_{50} (grass shrimp 96-hour)

ACUTE TOXICITY: LC_{50} (eastern oyster 96-hour)

OVERALL TOXICITY: Practically Non-Toxic (Based on freshwater data, imazapyr is not expected to be toxic to estuarine invertebrates.)

TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD_{50} (bobwhite quail) >2150 mg/kg

AVIAN ACUTE ORAL TOXICITY: LD_{50} (mallard duck) >2150 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (bobwhite quail) >5000 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (mallard duck) >5000 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD_{50} (rat) >5000 mg/kg

OVERALL TOXICITY: Practically Non-Toxic

BIOACCUMULATION POTENTIAL: Little Potential

THREATENED AND ENDANGERED SPECIES: Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

V. TOXICOLOGICAL DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD_{50} (rat) >5000 mg/kg

ACUTE DERMAL TOXICITY: LD_{50} (rabbit) >2000 mg/kg

PRIMARY SKIN IRRITATION: Rabbit - Slight Irritant

PRIMARY EYE IRRITATION: Rabbit – Moderate Irritant

ACUTE INHALATION: LC_{50} (rat) >1.3 mg/l

OVERALL TOXICITY: Category III – Slightly Toxic

CHRONIC TOXICITY:

CARCINOGENICITY: EPA Group E - No evidence of human carcinogenicity.

DEVELOPMENTAL/REPRODUCTIVE: No adverse effects.

MUTAGENICITY: No adverse effects.

HAZARD: The end-use product labels for the imazapyr formulations carry the *Caution* signal word due to potential eye and skin irritation.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: None.

CHRONIC TOXICITY:

REPORTED EFFECTS: None.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS: None.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: Dermal sensitizer in some applicators after prolonged and repeated contact with formulated products.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: None reported.

VII. SAFETY PRECAUTIONS

SIGNAL WORD AND DEFINITION:

IMAZAPYR - **CAUTION** – HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. AVOID BREATHING SPRAY MIST. AVOID CONTACT WITH SKIN, EYES OR CLOTHING. PROLONGED OR FREQUENT EXPOSURE TO SKIN MAY CAUSE ALLERGIC REACTIONS IN SOME INDIVIDUALS.

PROTECTIVE PRECAUTIONS FOR WORKERS: Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

EYES: Flush eyes with water.

SKIN: Wash all exposed areas with soap and water, call physician if irritation persists.

INGESTION: Drink 1 to 2 glasses of water and induce vomiting. Call physician.

INHALATION: Remove to fresh air. Call a physician if breathing difficulty persists.

HANDLING, STORAGE AND DISPOSAL: Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

EMERGENCY SPILL PROCEDURES AND HAZARDS: Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

VIII. DEFINITIONS

adsorption – the process of attaching to a surface

avian – of, or related to, birds

CAEPA – California Environmental Protection Agency

carcinogenicity – ability to cause cancer

CHEMTREC – Chemical Transportation Emergency Center

dermal – of, or related to, the skin

EC_{50} - median effective concentration during a bioassay

ecotoxicological – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

FIFRA – Federal Insecticide, Fungicide and Rodenticide Act

formulation – the form in which the pesticide is supplied by the manufacturer for use

half-life – the time required for half the amount of a substance to be reduced by natural processes

herbicide – a substance used to destroy plants or to slow down their growth

Hg – chemical symbol for mercury

IARC – International Agency for Research on Cancer

K(oc) – the tendency of a chemical to be adsorbed by soil, expressed as: K(oc) = conc. adsorbed/conc. dissolved/% organic carbon in soil

LC_{50} – the concentration in air, water, or food that will kill approximately 50% of the subjects

LD_{50} – the dose that will kill approximately 50% of the subjects

leach – to dissolve out by the action of water

mg/kg – weight ratio expressed as milligrams per kilogram

mg/l – weight-to-liquid ratio expressed as milligrams per liter

microorganisms – living things too small to be seen without a microscope

mPa – milli-Pascal (unit of pressure)

mutagenicity – ability to cause genetic changes

NFPA – National Fire Protection Association

NIOSH - National Institute for Occupational Safety and Health

NOEL - no observable effect level

non-target – animals or plants other than the ones that the pesticide is intended to kill or control

OSHA - Occupational Safety and Health Administration

Pa – Pascal (unit of pressure)

persistence – tendency of a pesticide to remain to remain in the environment after it is applied

pesticides – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

PPE – personal protective equipment

ppm – weight ratio expressed as parts per million

residual activity – the remaining amount of activity as a pesticide

T&E – Threatened and Endangered Species (from the Endangered Species Act)

µg – micrograms

volatility – the tendency to become a vapor at standard temperatures and pressures

IX. INFORMATION SOURCES

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http://www.fs.fed.us/foresthealth/pesticide/index.html

X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD_{50} (mg/kg)	Acute Dermal LD_{50} (mg/kg)	Acute Inhalation LC_{50} (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	**DANGER (poison)**	0–50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	**WARNING**	>50–500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	**CAUTION**	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	**NONE**	>5000	>20,000	>20	no irritation	Moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals Acute Oral LD_{50} mg/kg)	Avian Acute Oral LD_{50} (mg/kg)	Avian Acute Dietary LC_{50} (mg/kg)	Fish or Aquatic Invertebrates Acute Concentration LC_{50} (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.

Isoxaben

HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY

BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

I. BASIC INFORMATION

COMMON NAME: isoxaben

CHEMICAL NAME: N-[3-(1-ethyl-1-methylpropyl)-5-isoxazoly]-2,6dimethoxybenzamide and isomers

CAS No. 82558-50-7

CHEMICAL TYPE: benzamide family

PESTICIDE CLASSIFICATION: herbicide

REGISTERED USE STATUS: "General Use."

FORMULATIONS: Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the *Federal Register* on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the imazapyr formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the isoxaben formulation are listed below:

Gallery 75 DF®	Isoxaben	75%
	Inert	25%

RESIDUE ANALYTICAL METHODS: Information not available.

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES*:* Industrial sites, utility substations, highways.

OPERATIONAL DETAILS:

TARGET PLANTS: Isoxaben is used for pre-emergence control of certain broadleaf weeds in non-cropland areas. Does not control established weeds.

MODE OF ACTION: Isoxaben inhibits cell wall biosynthesis. Susceptible plants are killed prior to emergence.

METHOD OF APPLICATION: Isoxaben, a pre-emergence herbicide, is applied during planting and in established turf grasses/ open areas at an application rate of 0.66 to 1.66 pounds per acre.

SPECIAL PRECAUTIONS:

TIMING OF APPLICATION: Isoxaben, a pre-emergent weed herbicide, is applied during germination of the target plant. Isoxaben is also registered for use in established turf grasses to prevent growth of unwanted weeds.

DRIFT CONTROL: Isoxaben is mixed with water and applied using low-pressure sprayers. Isoxaben can be applied to dry soil, as water does not affect the effectiveness of the herbicide. Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas.

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: Isoxaben residual activity is reported not to exceed 6 months under normal application rates.

ADSORPTION: Isoxaben has a K(oc) of 1400 and is moderately adsorbed onto soils.

PERSISTENCE AND AGENTS OF DEGRADATION: The half-life of isoxaben in the soil is 100 days.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: Information not available.

WATER:

SOLUBILITY: Less than 1.0 mg/l water.

POTENTIAL FOR LEACHING INTO SURFACE OR GROUND WATER: There is a low potential for leaching into surface and groundwater.

AIR:

VOLATILIZATION: Isoxaben is slightly volatile at $<3.9 \times 10^{-7}$ mm Hg at 77° F.

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: Information is not available; however, the formulated product will emit toxic vapors as it burns.

IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

MICROORGANISMS:

ACUTE CONTACT TOXICITY: LD_{50} (honey bee contact) >100 µg/bee

OVERALL TOXICITY: Practically Non-Toxic

PLANTS: Contact will injure or kill target and non-target plants.

AQUATIC VERTEBRATES:

ACUTE TOXICITY: LC_{50} (rainbow trout 96-hour) 1.1 mg/l

ACUTE TOXICITY: LC_{50} (bluegill sunfish 96-hour) 1.1 mg/l

OVERALL TOXICITY: Moderately Toxic

AQUATIC FRESHWATER INVERTEBRATES:

ACUTE TOXICITY: LC_{50} (*Daphnia magna* 48-hour) >100 mg/l

OVERALL TOXICITY: Practically Non-Toxic

AQUATIC ESTUARINE/MARINE INVERTEBRATES:

ACUTE TOXICITY: LC_{50} (sheepshead minnow 96-hour)

ACUTE TOXICITY: LC_{50} (grass shrimp 96-hour)

ACUTE TOXICITY: LC_{50} (eastern oyster 96-hour)

OVERALL TOXICITY: Practically Non-Toxic (Based on freshwater data, imazapyr is not expected to be toxic to estuarine invertebrates.)

TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD_{50} (bobwhite quail)

AVIAN ACUTE ORAL TOXICITY: LD_{50} (mallard duck)

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (bobwhite quail) >5000 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (mallard duck) >5000 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD_{50} (rat) >5000 mg/kg

OVERALL TOXICITY: Practically Non-Toxic

BIOACCUMULATION POTENTIAL: Little Potential

THREATENED AND ENDANGERED SPECIES: Isoxaben may be a hazard if applied to pre-emerging endangered plants and if applied directly to waters containing endangered aquatic plant life. There is an indication that isoxaben may interfere with reproduction and may cause birth defects in animals.

V. TOXICOLOGICAL DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD_{50} (rat) >5000 mg/kg

ACUTE DERMAL TOXICITY: LD_{50} (rabbit) >2000 mg/kg

PRIMARY IRRITATION SCORE: Slight

PRIMARY EYE IRRITATION: Moderate. The formulated product may cause moderate eye irritation, which may be slow to heal. May cause slight temporary corneal injury.

ACUTE INHALATION: LC_{50} (rat) >2.68 mg/l

OVERALL TOXICITY: Category III – Caution – Slightly Toxic

CHRONIC TOXICITY:

CARCINOGENICITY: Isoxaben is considered slightly oncogenic. In addition, the formulated product contains crystalline silica (in kaolin), which is listed as a known carcinogen.

DEVELOPMENTAL: Unknown effects.

REPRODUCTIVE: Has been shown to interfere with reproduction in animals.

MUTAGENICITY: Isoxaben has caused birth defects in laboratory animals at doses toxic to the mother.

HAZARD: Based on the results of animal studies, isoxaben causes genetic damage and birth defects. There are data that support the finding that isoxaben has potential to have cancer-causing effects on animals.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: None reported.

CHRONIC TOXICITY:

REPORTED EFFECTS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS: Slight skin and eye irritation caused by clay (Kaolin) binding agents. Crystalline silica (in Kaolin) is listed as a carcinogen for hazard communication purposes under 29 CFR 1910.1200.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: There have been no reported effects on workers manufacturing the products.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: None reported.

HEALTH RISK MANAGEMENT PROCEDURES: See Section VII.

VII. SAFETY PRECAUTIONS

SIGNAL WORD AND DEFINITION:

ISOXABEN - **CAUTION** – CAUSES EYE IRRITATION AND HARMFUL IF INHALED.

PROTECTIVE PRECAUTIONS FOR WORKERS: Use safety glasses. Use impervious gloves when prolonged or frequently repeated contact could occur. In enclosed spaces, use NIOSH-approved dust respirator. Long-sleeved shirt, long pants, shoes, and socks are required for workers.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

EYES: Flush eyes with water; call physician if irritation develops.

SKIN: Wash all exposed areas with soap and water. Wash all contaminated clothing prior to reuse. Call a physician if irritation develops.

INGESTION: Call a physician or Poison Control Center. Immediately transport to a medical care facility.

INHALATION: Remove individual to fresh air. If breathing difficulty occurs, provide CPR assistance and seek immediate medical attention.

HANDLING, STORAGE AND DISPOSAL: Keep dry (below 120° F) and store away from food, feed, or other material to be used or consumed by humans or animals. Do not contaminate water. Dispose only in accordance with local, state and federal regulations.

EMERGENCY SPILL PROCEDURES AND HAZARDS: Contain and sweep up material of small spills and dispose as waste. Large spills should be reported to CHEMTREC (800-424-9300) for assistance. Prevent runoff. Do not contaminate water, food or feed by storage or disposal.

VIII. DEFINITIONS

adsorption – the process of attaching to a surface

avian – of, or related to, birds

CAEPA – California Environmental Protection Agency

carcinogenicity – ability to cause cancer

CHEMTREC – Chemical Transportation Emergency Center

dermal – of, or related to, the skin

EC_{50} - median effective concentration during a bioassay

ecotoxicological – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

FIFRA – Federal Insecticide, Fungicide and Rodenticide Act

formulation – the form in which the pesticide is supplied by the manufacturer for use

half-life – the time required for half the amount of a substance to be reduced by natural processes

herbicide – a substance used to destroy plants or to slow down their growth

Hg – chemical symbol for mercury

IARC – International Agency for Research on Cancer

K(oc) – the tendency of a chemical to be adsorbed by soil, expressed as: K(oc) = conc. adsorbed/conc. dissolved/% organic carbon in soil

LC_{50} – the concentration in air, water, or food that will kill approximately 50% of the subjects

LD_{50} – the dose that will kill approximately 50% of the subjects

leach – to dissolve out by the action of water

mg/kg – weight ratio expressed as milligrams per kilogram

mg/l – weight-to-liquid ratio expressed as milligrams per liter

microorganisms – living things too small to be seen without a microscope

mPa – milli-Pascal (unit of pressure)

mutagenicity – ability to cause genetic changes

NFPA – National Fire Protection Association

NIOSH - National Institute for Occupational Safety and Health

NOEL - no observable effect level

non-target – animals or plants other than the ones that the pesticide is intended to kill or control

OSHA - Occupational Safety and Health Administration

Pa – Pascal (unit of pressure)

persistence – tendency of a pesticide to remain to remain in the environment after it is applied

pesticides – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

PPE – personal protective equipment

ppm – weight ratio expressed as parts per million

residual activity – the remaining amount of activity as a pesticide

T&E – Threatened and Endangered Species (from the Endangered Species Act)

µg – micrograms

volatility – the tendency to become a vapor at standard temperatures and pressures

IX. INFORMATION SOURCES

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X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD_{50} (mg/kg)	Acute Dermal LD_{50} (mg/kg)	Acute Inhalation LC_{50} (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	**DANGER (poison)**	0–50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	**WARNING**	>50–500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	**CAUTION**	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	**NONE**	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals (Acute Oral LD_{50} mg/kg)	Avian (Acute Oral LD_{50} mg/kg)	Avian LC_{50} (mg/kg)	Fish or Aquatic Invertebrates LC_{50} (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.

Mefluidide

HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

I. BASIC INFORMATION

COMMON NAME: mefluidide

CHEMICAL NAME: N-[2,4-dimethyl-5-[[(trifluoromethyl)sulfonyl]amino]phenyl] acetamide

CAS No. 53780-34-0

CHEMICAL TYPE*:* acetamide compound

PESTICIDE CLASSIFICATION: plant growth regulator

REGISTERED USE STATUS: "General Use."

FORMULATIONS: Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the *Federal Register* on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the Embark® formulation are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the mefluidide formulations are listed below:

Embark®	Mefluidide	3.20%
	Inert	96.80%

RESIDUE ANALYTICAL METHODS: Following extraction, mefluidide is derivatized with diazomethane and analyzed by gas chromatography using flame ionization detection.

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES: Embark® is registered as a plant growth regulator to suppress seedhead formation and to regulate the vegetative growth of various turfgrass species and woody ornamentals in commercial, residential, public, and non-cropland areas.

OPERATIONAL DETAILS:

TARGET PLANTS: Many, mainly turfgrasses and weeds such as Johnsongrass, shattercane, volunteer corn, and volunteer sorghum.

MODE OF ACTION: Mefluidide inhibits the growth and development of the meristematic regions of the affected plants.

METHOD OF APPLICATION: Conventional power spray equipment using a non-ionic surfactant. Manufacturer recommends use of colorant to control even application.

SPECIAL PRECAUTIONS:

TIMING OF APPLICATION: Mefluidide must be applied before emergence of seedheads.

DRIFT CONTROL: Apply only when conditions will prevent drift to non-target areas and surface waters.

RESTRICTIONS/WARNINGS/LIMITATIONS: Do not apply through any type of irrigation system. Do not allow animals to graze treated areas.

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: Mefluidide residual activity is reported not to exceed 3 hours after application.

ADSORPTION: Mefluidide has a K(oc) of 200. Adsorption of mefluidide after 3 hours, however, is insignificant.

PERSISTENCE AND AGENTS OF DEGRADATION: The half-life of mefluidide is 4 days.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: Information not available.

WATER:

SOLUBILITY: 180 mg/l water at 23° C (Pure Compound)

POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER*:* Mefluidide is weakly adsorbed onto soil and organic particles but is not persistent in soils or plants. Leaching into groundwater should be minimal or nonexistent if application methods are followed.

SURFACE WATERS: See above.

AIR:

VOLATILIZATION: <13 mPa at 25° C (Pure Compound).

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: Information not available.

IV. ECOLOGICAL TOXICITY EFFECTS TO NON-TARGET SPECIES

MICROORGANISMS:

ACUTE CONTACT TOXICITY: LD_{50} (honey bee contact) >2 µg/bee

OVERALL TOXICITY: Practically Non-Toxic

PLANTS: Contact may injure or kill target and non-target plants.

AQUATIC VERTEBRATES:

ACUTE TOXICITY: LC_{50} (rainbow trout 96-hour) <100 mg/l

ACUTE TOXICITY: LC_{50} (bluegill sunfish 96-hour) <100 mg/l

OVERALL TOXICITY: Slightly Toxic

AQUATIC FRESHWATER INVERTEBRATES:

ACUTE TOXICITY: LC_{50} (*Daphnia magna* 48-hour) No information.

OVERALL TOXICITY: [Not available.]

AQUATIC ESTUARINE/MARINE INVERTEBRATES:

ACUTE TOXICITY: EC_{50} (Eastern oyster larvae 48-hour) No information.

ACUTE TOXICITY: LC_{50} (sheepshead minnow 96-hour) No information.

OVERALL TOXICITY: [Not available.]

TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD_{50} (mallard duck) >4640 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (bobwhite quail) >10,000 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (mallard duck) >10,000 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD_{50} (rat) >4000 mg/kg

OVERALL TOXICITY: Practically Non-Toxic

BIOACCUMULATION POTENTIAL: No Potential

THREATENED AND ENDANGERED SPECIES: Mefluidide may be a hazard if applied to pre-emerging endangered plants and if applied directly to waters containing endangered aquatic life. It probably would not be a hazard to most endangered terrestrial animals, due to its low toxicity.

V. TOXICOLOGICAL DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY

LD_{50} (rat) >4000 mg/kg
LD_{50} (mice) >1920 mg/kg

ACUTE DERMAL TOXICITY:

Rabbit LD_{50} >4,000 mg/kg

PRIMARY IRRITATION SCORE: none

PRIMARY EYE IRRITATION: Mild irritation to rabbits

ACUTE INHALATION: LC_{50} (rat, 4-hour) >8.5 mg/l.

OVERALL TOXICITY: Category III – Caution – Slightly Toxic

CHRONIC TOXICITY:

CARCINOGENICITY: No data.

DEVELOPMENTAL: No effects.

REPRODUCTIVE: No effects.

MUTAGENICITY: No effects.

HAZARD: Based on the results of animal studies, mefluidide does not cause genetic damage or birth defects and has little or no effect on fertility, reproduction or development of offspring. There are no data on the potential cancer-causing effects of mefluidide.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: None reported.

CHRONIC TOXICITY:

REPORTED EFFECTS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS: No information available.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: There have been no reported effects on workers manufacturing the products.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: None reported.

HEALTH RISK MANAGEMENT PROCEDURES: See Section VII.

VII. SAFETY PRECAUTIONS

SIGNAL WORD AND DEFINITION:

MEFLUIDIDE - **CAUTION** – HARMFUL IF SWALLOWED OR ABSORBED THROUGH THE SKIN. AVOID BREATHING SPRAY MIST. AVOID CONTACT WITH SKIN, EYES, OR CLOTHING. WEAR PROTECTIVE CLOTHING INCLUDING RUBBER GLOVES WHEN HANDLING.

PROTECTIVE PRECAUTIONS FOR WORKERS: Use safety glasses. Use impervious gloves when prolonged or frequently repeated contact could occur. Long-sleeved shirt, long pants, shoes, and socks are recommended.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

EYES: Flush eyes with water; call physician if irritation develops.

SKIN: Wash all exposed areas with soap and water. Wash all contaminated clothing prior to reuse. Call a physician if irritation develops.

INGESTION: Do not induce vomiting. Call a physician or Poison Control Center. Do not wait for symptoms to appear. Immediately transport to a medical care facility.

INHALATION: Remove individual to fresh air. If breathing difficulty occurs, provide CPR assistance and seek immediate medical attention.

HANDLING, STORAGE AND DISPOSAL: Keep dry and store away from food, feed, or other material to be used or consumed by humans or animals. Do not contaminate water. Dispose only in accordance with local, state and federal regulations.

EMERGENCY SPILL PROCEDURES AND HAZARDS: Contain and sweep up material of small spills and dispose as waste. Large spills should be reported to CHEMTREC (800-424-9300) for assistance. Prevent runoff. Do not contaminate water, food or feed by storage or disposal.

VIII. DEFINITIONS

adsorption – the process of attaching to a surface

avian – of, or related to, birds

CAEPA – California Environmental Protection Agency

carcinogenicity – ability to cause cancer

CHEMTREC – Chemical Transportation Emergency Center

dermal – of, or related to, the skin

EC_{50} - median effective concentration during a bioassay

ecotoxicological – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

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half-life – the time required for half the amount of a substance to be reduced by natural processes

herbicide – a substance used to destroy plants or to slow down their growth

Hg – chemical symbol for mercury

IARC – International Agency for Research on Cancer

K(oc) – the tendency of a chemical to be adsorbed by soil, expressed as: K(oc) = conc. adsorbed/conc. dissolved/% organic carbon in soil

LC_{50} – the concentration in air, water, or food that will kill approximately 50% of the subjects

LD_{50} – the dose that will kill approximately 50% of the subjects

leach – to dissolve out by the action of water

mg/kg – weight ratio expressed as milligrams per kilogram

mg/l – weight-to-liquid ratio expressed as milligrams per liter

microorganisms – living things too small to be seen without a microscope

mPa – milli-Pascal (unit of pressure)

mutagenicity – ability to cause genetic changes

NFPA – National Fire Protection Association

NIOSH - National Institute for Occupational Safety and Health

NOEL - no observable effect level

non-target – animals or plants other than the ones that the pesticide is intended to kill or control

OSHA - Occupational Safety and Health Administration

Pa – Pascal (unit of pressure)

persistence – tendency of a pesticide to remain to remain in the environment after it is applied

pesticides – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

PPE – personal protective equipment

ppm – weight ratio expressed as parts per million

residual activity – the remaining amount of activity as a pesticide

T&E – Threatened and Endangered Species (from the Endangered Species Act)

µg – micrograms

volatility – the tendency to become a vapor at standard temperatures and pressures

IX. INFORMATION SOURCES

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Weed Science Society of America, Herbicide Handbook, 6th Edition, 1989

X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD_{50} (mg/kg)	Acute Dermal LD_{50} (mg/kg)	Acute Inhalation LC_{50} (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	**DANGER (poison)**	0–50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	**WARNING**	>50–500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	**CAUTION**	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	**NONE**	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals (Acute Oral LD_{50} mg/kg)	Avian (Acute Oral LD_{50} mg/kg)	Avian LC_{50} (mg/kg)	Fish or Aquatic Invertebrates LC_{50} (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.

Metsulfuron-methyl

HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

I. BASIC INFORMATION

COMMON NAME: metsulfuron-methyl

CHEMICAL NAME: methyl 2-[[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]-carbonyl]amino]sulfonyl]benzoate

Cas No. 74223-64-6

CHEMICAL TYPE: sulfonylurea herbicide

PESTICIDE CLASSIFICATION: systemic, selective pre- and post-emergent herbicide

REGISTERED USE STATUS: "General Use."

FORMULATIONS: Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the Escort® formulation are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the metsulfuron-methyl formulation are listed below:

Escort®

Metsulfuron-methyl	60 %
Inert	40 %

RESIDUE ANALYTICAL METHODS: EPA Method 632.

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES: Metsulfuron-methyl as Escort® is registered for use in non-agricultural areas as a general weed and brush control herbicide. For terrestrial use only, however, Escort® is registered for use in floodplains where surface water is not present and in terrestrial areas of deltas and low-lying areas.

OPERATIONAL DETAILS:

TARGET PLANTS: Metsulfuron-methyl is a selective herbicide primarily for post-emergent control of annual, biennial, and perennial broadleaf weeds and brush. Escort® does have pre-emergent activity.

MODE OF ACTION: Metsulfuron-methyl enters the plant through the root zone and foliage, inhibiting the synthesis of key amino acids.

METHOD OF APPLICATION AND RATES: Broadcast and spot spray applications at 1/4 to 4 ounces of formulated product per acre. Ground and aerial application. Do not apply more than 4 ounces/acre/ year.

SPECIAL PRECAUTIONS:

TIMING OF APPLICATION: Timing is dependent on the target plant; however, application may be made at any time the ground is not frozen. As metsulfuron-methyl must move to the root zone to be effective for pre-emergent control, adequate soil moisture is necessary.

DRIFT CONTROL: Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

RESTRICTIONS/WARNINGS/LIMITATIONS: Do not enter or allow others to enter the treated area until sprays have dried. Do not apply through any type of irrigation system. Do not apply directly to water or areas where surface water is present, or to intertidal areas below the mean high water mark. Do not apply to irrigation banks or other ditch banks. Do not use on lawns. Do not use on walks, driveways, tennis courts, or other impermeable areas. Do not apply to frozen ground. Treated soil should remain undisturbed. Grazing and cut forage restrictions of 3 days post-application at rates of 1-2/3 to 3-1/3 ounces per acre. This herbicide is injurious to plants at extremely low concentrations. Non-target plants may be adversely affected from drift and run-off. Not for use in California.

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: The half-life of metsulfuron-methyl is 120 days.

ADSORPTION: The K(oc) of metsulfuron-methyl is 35.

PERSISTENCE AND AGENTS OF DEGRADATION: Metsulfuron-methyl is persistent with no major (>10%) degradates.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: Metsulfuron-methyl degrades to nonphytotoxic, low-molecular-weight compounds.

WATER:

SOLUBILITY: 2790 mg/l in water (pH 7).

POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER: Metsulfuron-methyl is moderately persistent and highly mobile and has potential to enter surface waters from runoff. The very low application rate and microbial breakdown suggest that metsulfuron-methyl has little potential to enter or ground water.

AIR:

VOLATILIZATION: Nonvolatile

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: Not known.

IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

MICROORGANISMS:

ACUTE CONTACT TOXICITY: LD_{50} (honey bee contact) >2 µg/bee

OVERALL TOXICITY: Practically Non-Toxic

PLANTS: Contact will injure or kill target and non-target plants.

AQUATIC VERTEBRATES:

ACUTE TOXICITY: LC_{50} (rainbow trout 96-hour) >150 mg/l

ACUTE TOXICITY: LC_{50} (bluegill sunfish 96-hour) >150 mg/l

OVERALL TOXICITY: Practically Non-Toxic

AQUATIC FRESHWATER INVERTEBRATES:

ACUTE TOXICITY: LC_{50} (*Daphnia magna* 48-hour) >150 mg/l

OVERALL TOXICITY: Practically Non-Toxic

AQUATIC ESTUARINE/MARINE INVERTEBRATES:

ACUTE TOXICITY: EC_{50} (Eastern oyster larvae 48-hour)

ACUTE TOXICITY: LC_{50} (sheepshead minnow 96-hour)

OVERALL TOXICITY: Practically Non-Toxic

TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD_{50} (bobwhite quail)

AVIAN ACUTE ORAL TOXICITY: LD_{50} (mallard duck) >2510 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (bobwhite quail) >5620 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (mallard duck) >5620 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD_{50} (rat) >5000 mg/kg

OVERALL TOXICITY: Practically Non-Toxic

BIOACCUMULATION POTENTIAL: No Potential

THREATENED AND ENDANGERED SPECIES: Federally listed plants may be adversely affected if the product is applied directly to the plants.

V. TOXICOLOGICAL DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD_{50} (rat) >5000 mg/kg

ACUTE DERMAL TOXICITY: LD_{50} (rabbit) >5000 mg/kg

PRIMARY SKIN IRRITATION: Rabbit - Mild Irritant

PRIMARY EYE IRRITATION: Rabbit – Moderate Irritant

ACUTE INHALATION: LC_{50} (rat) >5.3 mg/l

OVERALL TOXICITY: Category III – Caution

CHRONIC TOXICITY:

CARCINOGENICITY: No effects reported.

DEVELOPMENTAL/REPRODUCTIVE: No effects reported.

MUTAGENICITY: Not a mutagenic.

HAZARD: The end-use product label for Escort® carries the *Caution* signal word due to eye irritation.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: None.

CHRONIC TOXICITY:

REPORTED EFFECTS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS: None reported..

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: Mild, temporary skin and eye irritation.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: None reported.

VII. SAFETY PRECAUTIONS

SIGNAL WORD AND DEFINITION:

METSULFURON-METHYL **- CAUTION** – CAUSES EYE IRRITATION

PROTECTIVE PRECAUTIONS FOR WORKERS: Applicators and other handlers must wear long-sleeved shirt and long pants, and shoes plus socks.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

EYES: Flush eyes with water; call physician if irritation persists.

SKIN: Wash all exposed areas with soap and water; call physician if irritation persists.

INGESTION: No specific intervention is indicated as compound is not likely to be hazardous by ingestion. Consult a physician if necessary.

INHALATION: Remove to fresh air.

HANDLING, STORAGE AND DISPOSAL: Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

EMERGENCY SPILL PROCEDURES AND HAZARDS: Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

VIII. DEFINITIONS

adsorption – the process of attaching to a surface

avian – of, or related to, birds

CAEPA – California Environmental Protection Agency

carcinogenicity – ability to cause cancer

CHEMTREC – Chemical Transportation Emergency Center

dermal – of, or related to, the skin

EC_{50} - median effective concentration during a bioassay

ecotoxicological – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

FIFRA – Federal Insecticide, Fungicide and Rodenticide Act

formulation – the form in which the pesticide is supplied by the manufacturer for use

half-life – the time required for half the amount of a substance to be reduced by natural processes

herbicide – a substance used to destroy plants or to slow down their growth

Hg – chemical symbol for mercury

IARC – International Agency for Research on Cancer

K(oc) – the tendency of a chemical to be adsorbed by soil, expressed as: K(oc) = conc. adsorbed/conc. dissolved/% organic carbon in soil

LC_{50} – the concentration in air, water, or food that will kill approximately 50% of the subjects

LD_{50} – the dose that will kill approximately 50% of the subjects

leach – to dissolve out by the action of water

mg/kg – weight ratio expressed as milligrams per kilogram

mg/l – weight-to-liquid ratio expressed as milligrams per liter

microorganisms – living things too small to be seen without a microscope

mPa – milli-Pascal (unit of pressure)

mutagenicity – ability to cause genetic changes

NFPA – National Fire Protection Association

NIOSH - National Institute for Occupational Safety and Health

NOEL - no observable effect level

non-target – animals or plants other than the ones that the pesticide is intended to kill or control

OSHA - Occupational Safety and Health Administration

Pa – Pascal (unit of pressure)

persistence – tendency of a pesticide to remain to remain in the environment after it is applied

pesticides – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

PPE – personal protective equipment

ppm – weight ratio expressed as parts per million

residual activity – the remaining amount of activity as a pesticide

T&E – Threatened and Endangered Species (from the Endangered Species Act)

µg – micrograms

volatility – the tendency to become a vapor at standard temperatures and pressures

IX. INFORMATION SOURCES

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X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD_{50} (mg/kg)	Acute Dermal LD_{50} (mg/kg)	Acute Inhalation LC_{50} (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	**DANGER (poison)**	0–50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	**WARNING**	>50–500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	**CAUTION**	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	**NONE**	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals Acute Oral LD_{50} mg/kg)	Avian Acute Oral LD_{50} (mg/kg)	Avian Acute Dietary LC_{50} (mg/kg)	Fish or Aquatic Invertebrates Acute Concentration LC_{50} (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

Disclaimers and Other Legal Information:

Mention of a trademark, vendor, technique, or proprietary product does not imply or constitute an endorsement of the product by the United States Department of Energy - Bonneville Power Administration (USDOE-BPA), its employees, and its contractors, and does not imply or endorse any product to the exclusion of others. In all cases, the user is required by law to follow all pesticide label instructions and restrictions.

This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.

Oryzalin

HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

I. BASIC INFORMATION

COMMON NAME: oryzalin

CHEMICAL NAME: 3,5-dinitro-N4,N4-dipropylsulfanilamide

CAS No. 019044-88-3

CHEMICAL TYPE*:* 2,6-dinitroanline

PESTICIDE CLASSIFICATION: herbicide

REGISTERED USE STATUS: "General Use."

FORMULATIONS: Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the oryzalin formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.
The contents of the oryzalin formulation is listed below:

Surflan Herbicide (both formulations)

Oryzalin	40.4%
Inert	59.6%

RESIDUE ANALYTICAL METHODS: Pesticide Analytical Method Volume I FDA Multiresidue Protocols D and E.

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES: Oryzalin is registered for commercial and non-commercial application to established lawns, ornamental/shade trees, nonagricultural rights-of-way, power stations, and industrial and paved areas.

OPERATIONAL DETAILS:

TARGET PLANTS: Oryzalin is a non-selective, post-emergent herbicide for control of annual grasses, broadleaf weeds, herbaceous plants, woody shrubs and vines.

MODE OF ACTION: Oryzalin inhibits cell division.

METHOD OF APPLICATION: Oryzalin is applied at an application rate of 0.75 to 6.0 pounds per acre depending on use, formulation and application method.

SPECIAL PRECAUTIONS:

TIMING OF APPLICATION: Oryzalin is a post-emergence herbicide and is applied anytime after emergence of target plants.

DRIFT CONTROL: Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Aerial application is not allowed (see below).

RESTRICTIONS/WARNINGS: Oryzalin is NOT registered for use on residential lawns. Aerial application is RESTRICTED throughout the U.S., except for agricultural use in California. This herbicide is TOXIC to fish. DO NOT graze or feed forage to livestock in treated areas.

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: The half-life of oryzalin is 20 days.

ADSORPTION: The K(oc) of oryzalin is 75.

PERSISTENCE AND AGENTS OF DEGRADATION: Degradates of oryzalin have not been monitored.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: The manufacturer has not conducted environmental toxicity studies with the degradates of this product.

WATER:

SOLUBILITY: 2.5 mg/kg at 25 C.

POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER: The product has low potential to leach into surface and ground water.

AIR:

VOLATILIZATION: Oryzalin is not volatile.

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: Nitrogen oxides and other toxic gasses may be formed.

IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

MICROORGANISMS:

ACUTE CONTACT TOXICITY: LD_{50} (honey bee 48-hour) >11 µg/bee

OVERALL TOXICITY: Practically Non-Toxic

PLANTS: Contact will injure or kill target and non-target plants.

AQUATIC VERTEBRATES:

ACUTE TOXICITY: LC_{50} (rainbow trout 96-hour) 3.26 mg/l

ACUTE TOXICITY: LC_{50} (bluegill sunfish 96-hour) 2.88 mg/l

OVERALL TOXICITY: Moderately Toxic

AQUATIC INVERTEBRATES:

ACUTE TOXICITY: LC_{50} (*Daphnia Magna* 48-hour) 1.4 mg/l

OVERALL TOXICITY: Moderately Toxic

AQUATIC ESTUARINE/MARINE INVERTEBRATES: Studies not required by EPA. EPA calculates toxicity will be similar to freshwater invertebrates.

TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD_{50} (bobwhite quail) 506.7 mg/kg

AVIAN DIETARY TOXICITY: LC_{50} (mallard duck) >5000 mg/kg

SMALL MAMMAL ACUTE ORAL TOXICITY: LD_{50} >10,000 mg/kg

OVERALL TOXICITY: Slightly to Practically Non-Toxic

BIOACCUMULATION POTENTIAL: LOW POTENTIAL

THREATENED AND ENDANGERED SPECIES: Federally listed aquatic organisms may be at risk in shallow water adjacent to treated areas. In addition, oryzalin may adversely affect federally listed plants.

V. TOXICOLOGICAL DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD_{50} (rat) >10,000 mg/kg

ACUTE DERMAL TOXICITY: LD_{50} (rabbit) >2000 mg/kg

PRIMARY SKIN IRRITATION: No information available

PRIMARY EYE IRRITATION: Rabbit – Slightly Irritating

ACUTE INHALATION: LC_{50} (rat 4-hour) >3.17 mg/l.

OVERALL TOXICITY: Category III – Caution – Slightly Toxic

CHRONIC TOXICITY:

CARCINOGENICITY: Classified by EPA as a Group C possible human carcinogen based on mammary gland tumors.

DEVELOPMENTAL: Reduced maternal and fetal body weight and increased runts and bone development effects at high dose levels.

REPRODUCTIVE: Increase in liver and kidney weights and decreased food consumption and body weight gain at high dose levels.

MUTAGENICITY: No adverse effects.

HAZARD: Sufficient cancer risk is present to require PPE in all application methods, and extended reentry intervals.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: None reported.

CHRONIC TOXICITY:

REPORTED EFFECTS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS: Repeated excessive ingestion of propylene glycol may cause central nervous system effects.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: Temporary eye irritation. Prolonged or repeated exposure may cause allergic skin reactions.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: None reported.

HEALTH RISK MANAGEMENT PROCEDURES: See Section VII.

VII. SAFETY PRECAUTIONS

SIGNAL WORD AND DEFINITION:

ORYZALIN **- CAUTION** – AVOID CONTACT WITH EYES SKIN AND CLOTHING. HARMFUL IF SWALLOWED, INHALE, OR ABSORBED THROUGH THE SKIN

PROTECTIVE PRECAUTIONS FOR WORKERS: Wear eye protection. Wear long-sleeved shirt, long pants, shoes and socks, and waterproof gloves.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

EYES: Flush eyes with water; call physician.

SKIN: Wash all exposed areas with soap and water. Wash all contaminated clothing prior to reuse. Call a physician if irritation develops.

INGESTION: Do not induce vomiting. Call a physician or Poison Control Center. If available, administer activated charcoal (6-8 heaping teaspoonfuls) with a large quantity of water. Do not give by mouth to an unconscious person. Immediately transport to a medical care facility.

INHALATION: Remove individual to fresh air. If breathing difficulty occurs, provide CPR assistance and seek immediate medical attention.

HANDLING, STORAGE AND DISPOSAL: Keep dry (below 120° F) and store away from food, feed, or other material to be used or consumed by humans or animals. Do not contaminate water. Dispose of only in accordance with local, state and federal regulations.

EMERGENCY SPILL PROCEDURES AND HAZARDS: Contain and sweep up material of small spills and dispose as waste. Large spills should be reported to CHEMTREC (800-424-9300) for assistance. Prevent runoff. Do not contaminate water, food, or feed by storage or disposal.

VIII. DEFINITIONS

adsorption – the process of attaching to a surface

avian – of, or related to, birds

CAEPA – California Environmental Protection Agency

carcinogenicity – ability to cause cancer

CHEMTREC – Chemical Transportation Emergency Center

dermal – of, or related to, the skin

EC_{50} - median effective concentration during a bioassay

ecotoxicological – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

FIFRA – Federal Insecticide, Fungicide and Rodenticide Act

formulation – the form in which the pesticide is supplied by the manufacturer for use

half-life – the time required for half the amount of a substance to be reduced by natural processes

herbicide – a substance used to destroy plants or to slow down their growth

Hg – chemical symbol for mercury

IARC – International Agency for Research on Cancer

K(oc) – the tendency of a chemical to be adsorbed by soil, expressed as: K(oc) = conc. adsorbed/conc. dissolved/% organic carbon in soil

LC_{50} – the concentration in air, water, or food that will kill approximately 50% of the subjects

LD_{50} – the dose that will kill approximately 50% of the subjects

leach – to dissolve out by the action of water

mg/kg – weight ratio expressed as milligrams per kilogram

mg/l – weight-to-liquid ratio expressed as milligrams per liter

microorganisms – living things too small to be seen without a microscope

mPa – milli-Pascal (unit of pressure)

mutagenicity – ability to cause genetic changes

NFPA – National Fire Protection Association

NIOSH - National Institute for Occupational Safety and Health

NOEL - no observable effect level

non-target – animals or plants other than the ones that the pesticide is intended to kill or control

OSHA - Occupational Safety and Health Administration

Pa – Pascal (unit of pressure)

persistence – tendency of a pesticide to remain to remain in the environment after it is applied

pesticides – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

PPE – personal protective equipment

ppm – weight ratio expressed as parts per million

residual activity – the remaining amount of activity as a pesticide

T&E – Threatened and Endangered Species (from the Endangered Species Act)

µg – micrograms

volatility – the tendency to become a vapor at standard temperatures and pressures

IX. INFORMATION SOURCES

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X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD_{50} (mg/kg)	Acute Dermal LD_{50} (mg/kg)	Acute Inhalation LC_{50} (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	**DANGER (poison)**	0–50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	**WARNING**	>50–500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	**CAUTION**	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	**NONE**	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals (Acute Oral LD_{50} mg/kg)	Avian (Acute Oral LD_{50} mg/kg)	Avian LC_{50} (mg/kg)	Fish or Aquatic Invertebrates LC_{50} (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

Disclaimers and Other Legal Information:

This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.

Paclobutrazol

HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

I. BASIC INFORMATION

COMMON NAME: paclobutrazol

CHEMICAL NAME: (R*,R*)-(±)-β-[(4-chlorophenyl)methyl]-α-(1,1-dimethylethyl)-1H-1,2,4-triazole-1-ethanol

CAS No. 76738-62-2

CHEMICAL TYPE: Information not available.

PESTICIDE CLASSIFICATION*:* Plant Growth Regulator

REGISTERED USE STATUS: "General Use."

FORMULATIONS: Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the paclobutrazol formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the paclobutrazol formulation is listed below:

Profile® 2SC Tree Growth Regulator

Paclobutrazol	21.8%
Inert	78.2%

RESIDUE ANALYTICAL METHODS: Information not available.

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES: Paclobutrazol is registered for the reduction of terminal growth and pruning volume in trees not used for food production on sites such as utility rights-of-way, urban environments, and residential and non-crop areas.

OPERATIONAL DETAILS:

TARGET PLANTS: Paclobutrazol is a non-selective, post-emergent herbicide for control of annual grasses, broadleaf weeds, herbaceous plants, woody shrubs and vines.

MODE OF ACTION: Paclobutrazol is a xylem plant growth regulator that slows vegetative growth by inhibiting gibberellin biosynthesis.

METHOD OF APPLICATION: Paclobutrazol (as Profile®) is applied as a basal soil drench or by soil injection.

SPECIAL PRECAUTIONS:

TIMING OF APPLICATION: Paclobutrazol is a post-emergence growth regulator and is applied anytime after emergence of target plants. Effects may not be noticeable for up to eighteen months.

DRIFT CONTROL: Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions.

RESTRICTIONS/WARNINGS: Do not apply this product through any type of irrigation system.

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: The half-life of paclobutrazol is 200 days, depending on soil type.

ADSORPTION: The K(oc) of paclobutrazol is 400.

PERSISTENCE AND AGENTS OF DEGRADATION: Information not available.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: Information not available.

WATER:

SOLUBILITY: 35 mg/l at 25 C

POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER: The product has high potential to leach into surface and ground water.

AIR:

VOLATILIZATION: Paclobutrazol is slightly volatile.

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: Information not available.

IV. Ecological Toxicity Effects on Non-Target Species

Microorganisms:

Acute Contact Toxicity: LD_{50} (honey bee contact) >100 µg/bee

Overall Toxicity: **Practically Non-Toxic**

Plants: Contact will slow the growth of target and non-target trees.

Aquatic Vertebrates:

Acute Toxicity: LC_{50} (rainbow trout 96-hour) 27.8 mg/l

Acute Toxicity: LC_{50} (bluegill sunfish 96-hour) 23.6 mg/l

Overall Toxicity: Slightly Toxic

Aquatic Invertebrates:

Acute Toxicity: LC_{50} (*Daphnia Magna* 48-hour) 33.2 mg/l

Overall Toxicity: Slightly Toxic

Aquatic Estuarine/Marine Invertebrates: Studies not required by EPA. EPA calculates toxicity will be similar to freshwater invertebrates.

Terrestrial Animals:

Avian Acute Oral Toxicity: LD_{50} (mallard duck) 7913 mg/kg

Avian Dietary Toxicity: LC_{50} (mallard duck) >20,000 mg/kg

Avian Dietary Toxicity: LC_{50} (bobwhite quail) >5000 mg/kg

Small Mammal Acute Oral Toxicity: LD_{50} >2140 mg/kg

Overall Toxicity: Practically Non-Toxic

Bioaccumulation Potential: Low Potential

Threatened and Endangered Species: Due to the low toxicity and method of application, paclobutrazol is not expected to cause adverse effects to federally listed species.

V. Toxicological Data

Acute Toxicity:

Acute Oral Toxicity: LD_{50} (rat, female) 1330 mg/kg

Acute Dermal Toxicity: LD_{50} (rabbit) >2000 mg/kg

Primary Skin Irritation: Rabbit - Slightly irritating

Primary Eye Irritation: Rabbit - Moderately irritating

ACUTE INHALATION: LC_{50} (rat 4-hour) >250 mg/l.

OVERALL TOXICITY: Category III – Caution – Slightly Toxic

CHRONIC TOXICITY:

CARCINOGENICITY: No adverse effects.

DEVELOPMENTAL: Caused birth defects in lab animals at doses toxic to the mother.

REPRODUCTIVE: No adverse effects.

MUTAGENICITY: No adverse effects.

HAZARD: Harmful if swallowed or absorbed through the skin.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: None reported.

CHRONIC TOXICITY:

REPORTED EFFECTS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS: Repeated excessive ingestion of propylene glycol may cause central nervous system effects. Commercial bentonite may contain silica gel, which is listed as a potential carcinogen by IARC.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: Temporary eye irritation. Prolonged or repeated exposure may cause allergic skin reactions and lung effects.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: None reported.

HEALTH RISK MANAGEMENT PROCEDURES: See Section VII.

VII. SAFETY PRECAUTIONS

SIGNAL WORD AND DEFINITION:

Paclobutrazol **- CAUTION** – AVOID CONTACT WITH EYES SKIN AND CLOTHING. HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH THE SKIN

PROTECTIVE PRECAUTIONS FOR WORKERS: Wear eye protection. Wear long-sleeved shirt, long pants, shoes, socks, and waterproof gloves.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

EYES: Flush eyes with water; call physician.

SKIN: Wash all exposed areas in flowing water or shower. Wash all contaminated clothing prior to reuse. Call a physician if irritation develops.

INGESTION: Do not induce vomiting. Call a physician or Poison Control Center. Immediately transport to a medical care facility.

INHALATION: Remove individual to fresh air. If breathing difficulty occurs, provide CPR assistance and seek immediate medical attention.

HANDLING, STORAGE AND DISPOSAL: Keep dry (below 120° F) and store away from food, feed or other material to be used or consumed by humans or animals. Do not contaminate water. Dispose of only in accordance with local, state and federal regulations.

EMERGENCY SPILL PROCEDURES AND HAZARDS: Contain and sweep up material of small spills and dispose as waste. Large spills should be reported to CHEMTREC (800-424-9300) for assistance. Prevent runoff. Do not contaminate water, food, or feed by storage or disposal.

VIII. DEFINITIONS

adsorption – the process of attaching to a surface

avian – of, or related to, birds

CAEPA – California Environmental Protection Agency

carcinogenicity – ability to cause cancer

CHEMTREC – Chemical Transportation Emergency Center

dermal – of, or related to, the skin

EC_{50} - median effective concentration during a bioassay

ecotoxicological – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

FIFRA – Federal Insecticide, Fungicide and Rodenticide Act

formulation – the form in which the pesticide is supplied by the manufacturer for use

half-life – the time required for half the amount of a substance to be reduced by natural processes

herbicide – a substance used to destroy plants or to slow down their growth

Hg – chemical symbol for mercury

IARC – International Agency for Research on Cancer

K(oc) – the tendency of a chemical to be adsorbed by soil, expressed as: K(oc) = conc. adsorbed/conc. dissolved/% organic carbon in soil

LC_{50} – the concentration in air, water, or food that will kill approximately 50% of the subjects

LD_{50} – the dose that will kill approximately 50% of the subjects

leach – to dissolve out by the action of water

mg/kg – weight ratio expressed as milligrams per kilogram

mg/l – weight-to-liquid ratio expressed as milligrams per liter

microorganisms – living things too small to be seen without a microscope

mPa – milli-Pascal (unit of pressure)

mutagenicity – ability to cause genetic changes

NFPA – National Fire Protection Association

NIOSH - National Institute for Occupational Safety and Health

NOEL - no observable effect level

non-target – animals or plants other than the ones that the pesticide is intended to kill or control

OSHA - Occupational Safety and Health Administration

Pa – Pascal (unit of pressure)

persistence – tendency of a pesticide to remain to remain in the environment after it is applied

pesticides – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

PPE – personal protective equipment

ppm – weight ratio expressed as parts per million

residual activity – the remaining amount of activity as a pesticide

T&E – Threatened and Endangered Species (from the Endangered Species Act)

µg – micrograms

volatility – the tendency to become a vapor at standard temperatures and pressures

IX. INFORMATION SOURCES

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X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD_{50} (mg/kg)	Acute Dermal LD_{50} (mg/kg)	Acute Inhalation LC_{50} (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	**DANGER (poison)**	0–50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	**WARNING**	>50–500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	**CAUTION**	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	**NONE**	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals (Acute Oral LD_{50} mg/kg)	Avian (Acute Oral LD_{50} mg/kg)	Avian LC_{50} (mg/kg)	Fish or Aquatic Invertebrates LC_{50} (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

Disclaimers and Other Legal Information:

Mention of a trademark, vendor, technique, or proprietary product does not imply or constitute an endorsement of the product by the United States Department of Energy - Bonneville Power Administration (USDOE-BPA), its employees and its contractors, and does not imply or endorse any product to the exclusion of others. In all cases, the user is required by law to follow all pesticide label instructions and restrictions.

This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.

Picloram

HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

I. BASIC INFORMATION

COMMON NAME: picloram (potassium salt)

CHEMICAL NAME: 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1-H-imidazol-2-yl]-3-pyridinecarboxylic acid

Cas No. 2545-60-0

CHEMICAL TYPE: pyridinecarboxylic acid

PESTICIDE CLASSIFICATION: herbicide

REGISTERED USE STATUS: Restricted Use Pesticide in All States.

FORMULATIONS: Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the picloram formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.
The contents of the picloram formulation are listed below:

Tordon® 22K Herbicide

Picloram	28.7 %
Inert	71.3 %

RESIDUE ANALYTICAL METHODS: EPA Method 600/4-88-039 515.1; 515.2;555.

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES: Picloram is registered for use in non-crop sites for selective and total plant control. For terrestrial use only.

OPERATIONAL DETAILS:

TARGET PLANTS: Picloram is used for control woody plants on rights-of-ways and for the control of noxious weeds on rangeland.

MODE OF ACTION: Picloram is absorbed by the leaves, bark and roots, interfering with the plant's ability to produce proteins and nucleic acids.

METHOD OF APPLICATION AND RATES: Aerial and ground broadcast, spot, and localized applications at 1/4 pint to 1 quart per acre, not to exceed 2 quarts/acre/year (Tordon© 22K).

SPECIAL PRECAUTIONS:

TIMING OF APPLICATION: For weeds, best results are achieved when the plants are small and actively growing.

DRIFT CONTROL: Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

RESTRICTIONS/WARNINGS/LIMITATIONS: Do not enter the treated area until the spray has dried. Do not apply through any type of irrigation system. Do not graze or feed forage from treated areas for 2 weeks after treatment. Groundwater advisory. Surface water and drift advisory. Non-target plant advisory.

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: The half-life of picloram is 90 days.

ADSORPTION: The K(oc) of picloram is 16.

PERSISTENCE AND AGENTS OF DEGRADATION: Picloram is moderately persistent in the plant and soils. The primary route of degradation is microbial activity.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: Breaks down into carbon dioxide, oxalic acid, 4-amino-2,3,5-trichloropyridine and 4-amino-3,5-dichloro-6-hydroxypicolinic acid.

WATER:

SOLUBILITY: 200,000 mg/l in water (pH 7 at 25° C).

POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER: Picloram is moderately persistent with a moderate soil adsorption coefficient. There is a very high potential for picloram to leach into groundwater and a high potential for surface water runoff.

AIR:

VOLATILIZATION: No information.

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: Not known.

IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

MICROORGANISMS:

ACUTE CONTACT TOXICITY: LD_{50} (honey bee contact) >100 µg/bee

OVERALL TOXICITY: Practically Non-Toxic

PLANTS: Contact will injure or kill target and non-target plants.

AQUATIC VERTEBRATES:

ACUTE TOXICITY: LC_{50} (rainbow trout 96-hour) 13 mg/l

ACUTE TOXICITY: LC_{50} (bluegill sunfish 96-hour) 24 mg/l

OVERALL TOXICITY: Slightly Toxic

AQUATIC FRESHWATER INVERTEBRATES:

ACUTE TOXICITY: LC_{50} (*Daphnia magna* 48-hour) 68.3 mg/l

OVERALL TOXICITY: Slightly Toxic

AQUATIC ESTUARINE/MARINE INVERTEBRATES:

ACUTE TOXICITY: EC_{50} (grass shrimp 96-hour) 306 mg/l

ACUTE TOXICITY: EC_{50} (eastern oyster 96-hour) 18 mg/l

OVERALL TOXICITY: Slightly Toxic

TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD_{50} (mallard duck) >2250 mg/kg

AVIAN ACUTE ORAL TOXICITY: LD_{50} (bobwhite quail) >2250 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (bobwhite quail) >10,000 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (mallard duck) >10,000 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD_{50} (rat) >5000 mg/kg

OVERALL TOXICITY: Practically Non-Toxic

BIOACCUMULATION POTENTIAL: Little Potential

THREATENED AND ENDANGERED SPECIES: Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

V. TOXICOLOGICAL DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD_{50} (rat) >5000 mg/kg

ACUTE DERMAL TOXICITY: LD_{50} (rabbit) >2000 mg/kg

PRIMARY SKIN IRRITATION: Rabbit - Non-Irritant

PRIMARY EYE IRRITATION: Rabbit – Moderate Irritant

ACUTE INHALATION: LC_{50} (rat) >8.11 mg/l

OVERALL TOXICITY: Category III – Slightly Toxic

CHRONIC TOXICITY:

CARCINOGENICITY: EPA Group E - No evidence of human carcinogenicity.

DEVELOPMENTAL/REPRODUCTIVE: Body weight gains/losses, abortions, excess salivation.

MUTAGENICITY: No adverse effects.

HAZARD: The end-use product labels for the picloram formulations carry the *Caution* signal word due to potential eye irritation.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: Damage to central nervous system, weakness, diarrhea and weight loss.

CHRONIC TOXICITY:

REPORTED EFFECTS: Liver damage.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: See effects reported under acute toxicity.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS: None.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: None reported .

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: None reported.

VII. SAFETY PRECAUTIONS

SIGNAL WORD AND DEFINITION:

PICLORAM - **CAUTION** – CAUSES MODERATE EYE IRRITATION.

PROTECTIVE PRECAUTIONS FOR WORKERS: Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

EYES: Flush eyes with water for 15 minutes. Call physician.

SKIN: Wash all exposed areas with soap and water, call physician if irritation persists.

INGESTION: Call physician. Do not induce vomiting.

INHALATION: Remove to fresh air. Call a physician if breathing difficulty persists.

HANDLING, STORAGE AND DISPOSAL: Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

EMERGENCY SPILL PROCEDURES AND HAZARDS: Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food or feed by storage or disposal.

VIII. DEFINITIONS

adsorption – the process of attaching to a surface

avian – of, or related to, birds

CAEPA – California Environmental Protection Agency

carcinogenicity – ability to cause cancer

CHEMTREC – Chemical Transportation Emergency Center

dermal – of, or related to, the skin

EC_{50} - median effective concentration during a bioassay

ecotoxicological – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

FIFRA – Federal Insecticide, Fungicide and Rodenticide Act

formulation – the form in which the pesticide is supplied by the manufacturer for use

half-life – the time required for half the amount of a substance to be reduced by natural processes

herbicide – a substance used to destroy plants or to slow down their growth

Hg – chemical symbol for mercury

IARC – International Agency for Research on Cancer

K(oc) – the tendency of a chemical to be adsorbed by soil, expressed as: K(oc) = conc. adsorbed/conc. dissolved/% organic carbon in soil

LC_{50} – the concentration in air, water, or food that will kill approximately 50% of the subjects

LD_{50} – the dose that will kill approximately 50% of the subjects

leach – to dissolve out by the action of water

mg/kg – weight ratio expressed as milligrams per kilogram
mg/l – weight-to-liquid ratio expressed as milligrams per liter
microorganisms – living things too small to be seen without a microscope
mPa – milli-Pascal (unit of pressure)
mutagenicity – ability to cause genetic changes
NFPA – National Fire Protection Association
NIOSH - National Institute for Occupational Safety and Health
NOEL - no observable effect level
non-target – animals or plants other than the ones that the pesticide is intended to kill or control
OSHA - Occupational Safety and Health Administration
Pa – Pascal (unit of pressure)
persistence – tendency of a pesticide to remain to remain in the environment after it is applied
pesticides – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA
PPE – personal protective equipment
ppm – weight ratio expressed as parts per million
residual activity – the remaining amount of activity as a pesticide
T&E – Threatened and Endangered Species (from the Endangered Species Act)
µg – micrograms
volatility – the tendency to become a vapor at standard temperatures and pressures

IX. INFORMATION SOURCES

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http://www.epa.gov/oppsrrd1/REDs/

X. Toxicity Category Tables

Table I: Human Hazards

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD_{50} (mg/kg)	Acute Dermal LD_{50} (mg/kg)	Acute Inhalation LC_{50} (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	**DANGER (poison)**	0–50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	**WARNING**	>50–500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	**CAUTION**	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	**NONE**	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

Table II: Ecotoxicological Risks to Wildlife (Terrestrial and Aquatic)

Risk Category	Mammals Acute Oral LD_{50} mg/kg)	Avian Acute Oral LD_{50} (mg/kg)	Avian Acute Dietary LC_{50} (mg/kg)	Fish or Aquatic Invertebrates Acute Concentration LC_{50} (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.

Sulfometuron-methyl

HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

I. BASIC INFORMATION

COMMON NAME: sulfometuron-methyl

CHEMICAL NAME: {Methyl 2-[[[[(4,6-dimethyl-2-pyrimidinyl)amino]-carbonyl]amino]sulfonyl]benzoate}

Cas No. 74222-97-2

CHEMICAL TYPE: sulfonylurea herbicide

PESTICIDE CLASSIFICATION: herbicide

REGISTERED USE STATUS: "General Use."

FORMULATIONS: Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the Oust® formulation are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the sulfometuron-methyl formulation are listed below:

Oust®

Sulfometuron-methyl	75 %
Inert	25 %

RESIDUE ANALYTICAL METHODS: EPA METHOD 632

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES: Sulfometuron-methyl as Oust® is registered for use in non-agricultural areas as a general weed and brush control herbicide. For terrestrial use only.

OPERATIONAL DETAILS:

TARGET PLANTS: Sulfometuron-methyl is a selective herbicide primarily for post-emergent control of annual, biennial, and perennial broadleaf weeds and brush. Oust® does have pre-emergent activity.

MODE OF ACTION: Sulfometuron-methyl enters the plant through the root zone and foliage, inhibiting the synthesis of key amino acids.

METHOD OF APPLICATION AND RATES: Broadcast and spot spray applications at 1/4 ounce to 8 ounces of formulated product per acre. Ground or aerial (helicopter only) application. Do not apply more than 8 ounces/acre/year.

SPECIAL PRECAUTIONS:

TIMING OF APPLICATION: Timing is dependent on the target plant. Application may be made at any time the ground is not frozen. As sulfometuron-methyl must move to the root zone to be effective for pre-emergent control, adequate soil moisture is necessary.

DRIFT CONTROL: Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

RESTRICTIONS/WARNINGS/LIMITATIONS: Do not enter or allow others to enter the treated area until sprays have dried. Do not apply through any type of irrigation system. Do not apply directly to water or areas where surface water is present, or to intertidal areas below the mean high water mark. Do not apply to irrigation banks or other ditch banks. Do not use on lawns. Do not use on walks, driveways, tennis courts, or other impermeable areas. Do not apply to frozen ground. Treated soil should remain undisturbed. Grazing and cut forage restrictions of 12 months post-application apply. This herbicide is injurious to plants at extremely low concentrations. Non-target plants may be adversely affected from drift and run-off. Not for use in California.

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: The half-life of sulfometuron-methyl is 20 days.

ADSORPTION: The K(oc) of sulfometuron-methyl is 78.

PERSISTENCE AND AGENTS OF DEGRADATION: Sulfometuron-methyl is slightly persistent with no major (>10%) degradates.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: Sulfometuron-methyl degrades to nonphytotoxic, low-molecular-weight compounds and carbon dioxide.

WATER:

SOLUBILITY: 244 mg/l in water (pH 7).

POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER: Sulfometuron-methyl is slightly persistent and slightly mobile and has low potential to enter surface waters from runoff. The very low application rate and microbial breakdown suggest that sulfometuron-methyl has little potential to enter ground water.

AIR:

VOLATILIZATION: Nonvolatile.

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: Not known.

IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

MICROORGANISMS:

ACUTE CONTACT TOXICITY: LD_{50} (honey bee contact) >100 µg/bee

OVERALL TOXICITY: Practically Non-Toxic

PLANTS: Contact will injure or kill target and non-target plants.

AQUATIC VERTEBRATES:

ACUTE TOXICITY: LC_{50} (rainbow trout 96-hour) >148 mg/l

ACUTE TOXICITY: LC_{50} (bluegill sunfish 96-hour) >150 mg/l

OVERALL TOXICITY: Practically Non-Toxic

AQUATIC FRESHWATER INVERTEBRATES:

ACUTE TOXICITY: LC_{50} (*Daphnia magna* 48-hour) >150 mg/l

OVERALL TOXICITY: Practically Non-Toxic

AQUATIC ESTUARINE/MARINE INVERTEBRATES:

ACUTE TOXICITY: EC_{50} (Eastern oyster larvae 48-hour)

ACUTE TOXICITY: LC_{50} (sheepshead minnow 96-hour) >45 mg/l

OVERALL TOXICITY: Practically Non-Toxic

TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD_{50} (bobwhite quail) >5000 mg/kg

AVIAN ACUTE ORAL TOXICITY: LD_{50} (mallard duck) >5000 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (bobwhite quail) >5620 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (mallard duck) >5000 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD_{50} (rat) >5000 mg/kg

OVERALL TOXICITY: Practically Non-Toxic

BIOACCUMULATION POTENTIAL: No Potential

THREATENED AND ENDANGERED SPECIES: Federally listed plants may be adversely affected if the product is applied directly to the plants.

V. TOXICOLOGICAL DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD_{50} (rat) >5000 mg/kg

ACUTE DERMAL TOXICITY: LD_{50} (rabbit) >2000 mg/kg

PRIMARY SKIN IRRITATION: Rabbit - Slight Irritant

PRIMARY EYE IRRITATION: Rabbit – Moderate Irritant

ACUTE INHALATION: LC_{50} (rat) >5.1 mg/l

OVERALL TOXICITY: Category III – Caution

CHRONIC TOXICITY:

CARCINOGENICITY: No effects reported.

DEVELOPMENTAL/REPRODUCTIVE: No effects reported.

MUTAGENICITY: Not a mutagenic.

HAZARD: The end-use product label for Oust® carries the *Caution* signal word due to eye irritation.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: Ingestion of large amounts of sulfometuron may cause red cell destruction.

CHRONIC TOXICITY:

REPORTED EFFECTS: Reduced red cell count, increased liver weights, increased while cell count, and anemia reported in test animals at highest doses.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: None reported and none expected at application rates.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS: None reported.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: Mild, temporary skin and eye irritation.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: None reported.

VII. SAFETY PRECAUTIONS

SIGNAL WORD AND DEFINITION:

SULFOMETURON-METHYL **- CAUTION** – CAUSES MODERATE EYE IRRITATION

PROTECTIVE PRECAUTIONS FOR WORKERS: Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

EYES: Flush eyes with water; call physician if irritation persists.

SKIN: Wash all exposed areas with soap and water; call physician if irritation persists.

INGESTION: Immediately give 2 glasses of water and induce vomiting. Call a physician.

INHALATION: Remove to fresh air.

HANDLING, STORAGE AND DISPOSAL: Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

EMERGENCY SPILL PROCEDURES AND HAZARDS: Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

VIII. DEFINITIONS

adsorption – the process of attaching to a surface
avian – of, or related to, birds
CAEPA – California Environmental Protection Agency
carcinogenicity – ability to cause cancer
CHEMTREC – Chemical Transportation Emergency Center
dermal – of, or related to, the skin
EC_{50} - median effective concentration during a bioassay
ecotoxicological – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment
FIFRA – Federal Insecticide, Fungicide and Rodenticide Act
formulation – the form in which the pesticide is supplied by the manufacturer for use
half-life – the time required for half the amount of a substance to be reduced by natural processes
herbicide – a substance used to destroy plants or to slow down their growth
Hg – chemical symbol for mercury

IARC – International Agency for Research on Cancer

K(oc) – the tendency of a chemical to be adsorbed by soil, expressed as: K(oc) = conc. adsorbed/conc. dissolved/% organic carbon in soil

LC_{50} – the concentration in air, water, or food that will kill approximately 50% of the subjects

LD_{50} – the dose that will kill approximately 50% of the subjects

leach – to dissolve out by the action of water

mg/kg – weight ratio expressed as milligrams per kilogram

mg/l – weight-to-liquid ratio expressed as milligrams per liter

microorganisms – living things too small to be seen without a microscope

mPa – milli-Pascal (unit of pressure)

mutagenicity – ability to cause genetic changes

NFPA – National Fire Protection Association

NIOSH - National Institute for Occupational Safety and Health

NOEL - no observable effect level

non-target – animals or plants other than the ones that the pesticide is intended to kill or control

OSHA - Occupational Safety and Health Administration

Pa – Pascal (unit of pressure)

persistence – tendency of a pesticide to remain to remain in the environment after it is applied

pesticides – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

PPE – personal protective equipment

ppm – weight ratio expressed as parts per million

residual activity – the remaining amount of activity as a pesticide

T&E – Threatened and Endangered Species (from the Endangered Species Act)

µg – micrograms

volatility – the tendency to become a vapor at standard temperatures and pressures

IX. INFORMATION SOURCES

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X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD_{50} (mg/kg)	Acute Dermal LD_{50} (mg/kg)	Acute Inhalation LC_{50} (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	**DANGER (poison)**	0–50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	**WARNING**	>50–500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	**CAUTION**	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	**NONE**	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD_{50} mg/kg)	Acute Oral LD_{50} (mg/kg)	Acute Dietary LC_{50} (mg/kg)	Acute Concentration LC_{50} (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.

Tebuthiuron

HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

I. BASIC INFORMATION

COMMON NAME: tebuthiuron

CHEMICAL NAME: N-[5-(1,1-dimethylethyl)-1,3,4-thiadiazol-2-yl]-N,N'-dimethylurea

Cas No. 34014-18-1

CHEMICAL TYPE: substituted urea

PESTICIDE CLASSIFICATION: herbicide

REGISTERED USE STATUS: General Use Pesticide. Restricted Use Pesticide in Washington.

FORMULATIONS: Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the tebuthiuron formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the tebuthiuron formulations are listed below:

Spike® 20 P Herbicide

Tebuthiuron	20 %
Inert	80 %

Spike® 80 DF Herbicide

Tebuthiuron	80 %
Inert	20 %

Spike® 80 W Herbicide

Tebuthiuron	80 %
Inert	20 %

RESIDUE ANALYTICAL METHODS: EPA Method 632.

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES: Tebuthiuron is registered for use in non-crop sites for selective and total plant control. For terrestrial use only.

OPERATIONAL DETAILS:

TARGET PLANTS: Tebuthiuron is a pre- and post-emergent total herbicidal control for weeds and brush.

MODE OF ACTION: Tebuthiuron is absorbed by the roots inhibiting photosynthesis.

METHOD OF APPLICATION AND RATES: Aerial and ground broadcast, spot and localized applications at 0.2 to 2.5 lbs./acre.

SPECIAL PRECAUTIONS:

TIMING OF APPLICATION: Just before or during active plant growth.

DRIFT CONTROL: Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

RESTRICTIONS/WARNINGS/LIMITATIONS: Do not apply more than 1.25 lb./acre of any Spike formulation in areas with less than 20 inches of annual rainfall. Don not apply more than 2.5 lb./acre of any Spike formulation in areas with more than 20 inches of annual rainfall. Do not enter the treated area until the spray has dried. Do not apply through any type of irrigation system. Do not graze or feed forage from treated areas for 2 weeks after treatment. Groundwater advisory. Do not apply within areas identified as groundwater protection zones. Surface water and drift advisory. Non-target plant advisory.

III. Environmental Effects/Fate

Soil:

Residual Soil Activity: The half-life of tebuthiuron is 360 days.

Adsorption: The K(oc) of tebuthiuron is 80.

Persistence and Agents of Degradation: Tebuthiuron is highly persistent in the plant and soils. The primary route of degradation is microbial activity.

Metabolites/Degradation Products and Potential Environmental Effects: Breakdown products are found in very low concentrations and should be relatively non-toxic.

Water:

Solubility: 2500 mg/l in water (pH 7 at 25° C).

Potential for Leaching into Surface and Ground Water: Tebuthiuron is moderately persistent with a moderate soil adsorption coefficient. There is a very high potential for tebuthiuron to leach into groundwater and a high potential for surface water runoff.

Air:

Volatilization: 0.27 mPa at 25° C.

Potential for Byproducts from Burning of Treated Vegetation: Not known.

IV. Ecological Toxicity Effects on Non-Target Species

Microorganisms:

Acute Contact Toxicity: LD_{50} (honey bee contact) 30 ug/bee

Overall Toxicity: Slightly Toxic

Plants: Contact will injure or kill target and non-target plants.

Aquatic Vertebrates:

Acute Toxicity: LC_{50} (rainbow trout 96-hour) 87 mg/l

Acute Toxicity: LC_{50} (bluegill sunfish 96-hour) 87 mg/l

Overall Toxicity: Slightly Toxic

Aquatic Freshwater Invertebrates:

Acute Toxicity: LC_{50} (*Daphnia magna* 48-hour) 225 mg/l

Overall Toxicity: Practically Non-Toxic

AQUATIC ESTUARINE/MARINE INVERTEBRATES:

ACUTE TOXICITY: EC_{50} (pink shrimp 96-hour) 48 mg/l

ACUTE TOXICITY: EC_{50} (fiddler crab 96-hour) 320 mg/l

OVERALL TOXICITY: Slightly Toxic

TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD_{50} (mallard duck) >2500 mg/kg

AVIAN ACUTE ORAL TOXICITY: LD_{50} (bobwhite quail) >2500 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (bobwhite quail) >5000 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (mallard duck) >5000 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD_{50} (rat) 644 mg/kg

OVERALL TOXICITY: Slightly Toxic

BIOACCUMULATION POTENTIAL: Little Potential

THREATENED AND ENDANGERED SPECIES: Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

V. TOXICOLOGICAL DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD_{50} (rat) 644 mg/kg

ACUTE DERMAL TOXICITY: LD_{50} (rabbit) >200 mg/kg

PRIMARY SKIN IRRITATION: Rabbit - Slight Irritant

PRIMARY EYE IRRITATION: Rabbit – Slight Irritant

ACUTE INHALATION: LC_{50} (rat) 3.7 mg/l

OVERALL TOXICITY: Category III – Slightly Toxic

CHRONIC TOXICITY:

CARCINOGENICITY: EPA Group E - Not classifiable as a human carcinogen.

DEVELOPMENTAL/REPRODUCTIVE: No adverse effects.

MUTAGENICITY: No adverse effects.

HAZARD: The end-use product labels for the tebuthiuron formulations carry the *Caution* signal word due to potential eye skin and inhalation hazards.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: Eye irritation, skin irritation, nausea, vomiting, dizziness, sweating, headache and sore throat have been reported.

CHRONIC TOXICITY:

REPORTED EFFECTS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: See effects reported under acute toxicity.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS: None.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: Both Spike 20P and 80W contain kaolin. Kaolin, or crystalline silica, is listed as a carcinogen.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: None reported.

VII. SAFETY PRECAUTIONS

SIGNAL WORD AND DEFINITION:

TEBUTHIURON - **CAUTION** – CAUSES EYE IRRITATION. HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH THE SKIN.

PROTECTIVE PRECAUTIONS FOR WORKERS: Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

EYES: Flush eyes with water for 15 minutes. Call physician.

SKIN: Wash all exposed areas with soap and water, call physician if irritation persists.

INGESTION: Call physician. Do not induce vomiting.

INHALATION: Remove to fresh air. Call a physician if breathing difficulty persists.

HANDLING, STORAGE AND DISPOSAL: Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

EMERGENCY SPILL PROCEDURES AND HAZARDS: Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

VIII. DEFINITIONS

adsorption – the process of attaching to a surface

avian – of, or related to, birds

CAEPA – California Environmental Protection Agency

carcinogenicity – ability to cause cancer

CHEMTREC – Chemical Transportation Emergency Center

dermal – of, or related to, the skin

EC_{50} - median effective concentration during a bioassay

ecotoxicological – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

FIFRA – Federal Insecticide, Fungicide and Rodenticide Act

formulation – the form in which the pesticide is supplied by the manufacturer for use

half-life – the time required for half the amount of a substance to be reduced by natural processes

herbicide – a substance used to destroy plants or to slow down their growth

Hg – chemical symbol for mercury

IARC – International Agency for Research on Cancer

K(oc) – the tendency of a chemical to be adsorbed by soil, expressed as: K(oc) = conc. adsorbed/conc. dissolved/% organic carbon in soil

LC_{50} – the concentration in air, water, or food that will kill approximately 50% of the subjects

LD_{50} – the dose that will kill approximately 50% of the subjects

leach – to dissolve out by the action of water

mg/kg – weight ratio expressed as milligrams per kilogram

mg/l – weight-to-liquid ratio expressed as milligrams per liter

microorganisms – living things too small to be seen without a microscope

mPa – milli-Pascal (unit of pressure)

mutagenicity – ability to cause genetic changes

NFPA – National Fire Protection Association

NIOSH - National Institute for Occupational Safety and Health

NOEL - no observable effect level

non-target – animals or plants other than the ones that the pesticide is intended to kill or control

OSHA - Occupational Safety and Health Administration

Pa – Pascal (unit of pressure)

persistence – tendency of a pesticide to remain to remain in the environment after it is applied

pesticides – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

PPE – personal protective equipment

ppm – weight ratio expressed as parts per million

residual activity – the remaining amount of activity as a pesticide

T&E – Threatened and Endangered Species (from the Endangered Species Act)

µg – micrograms

volatility – the tendency to become a vapor at standard temperatures and pressures

IX. INFORMATION SOURCES

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Dow AgroSciences, Tordon® 22K Specialty Herbicide, Material Safety Data Sheet, MSDS: 000380, October 6, 1998

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USEPA, Office of Pesticide Programs, R.E.D. Facts, Tebuthiuron, EPA-738-F-95-018, August 1995 http://www.epa.gov/oppsrrd1/REDs/

X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD_{50} (mg/kg)	Acute Dermal LD_{50} (mg/kg)	Acute Inhalation LC_{50} (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	**DANGER (poison)**	0–50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	**WARNING**	>50–500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	**CAUTION**	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	**NONE**	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals	Avian	Avian	Fish or Aquatic Invertebrates
	Acute Oral LD_{50} mg/kg)	Acute Oral LD_{50} (mg/kg)	Acute Dietary LC_{50} (mg/kg)	Acute Concentration LC_{50} (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.

Triclopyr

HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

I. BASIC INFORMATION

COMMON NAME: triclopyr

CHEMICAL NAME: [((3,5,6-trichloro-2-pyridinyl)oxy)acetic acid]

Cas No. 55335-06-3

Of the parent chemical, two sibling forms are used in herbicide formulations:

Triclopyr butoxyethyl ester (BEE), Cas No. 64700-56-7, and

Triclopyr triethylamine salt (TEA), Cas No. 57213-69-1

CHEMICAL TYPE: pyridinyloxyacetic acids

PESTICIDE CLASSIFICATION: herbicide

REGISTERED USE STATUS: "General Use Pesticide."

FORMULATIONS: Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the triclopyr formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the triclopyr formulations are listed below:

Forestry Garlon® 4 Herbicide

Triclopyr (BEE)	61.6 %
Inert	38.4 %

Garlon ® 3A Herbicide

Triclopyr (TEA)	44.4 %
Inert	55.6 %

Garlon® 4 Herbicide

Triclopyr (BEE)	61.6 %
Inert	38.4 %

Pathfinder® II Herbicide

Triclopyr (BEE)	13.6 %
Inert	86.4 %

RESIDUE ANALYTICAL METHODS: EPA Method 632.

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES: Triclopyr is registered for use in non-crop sites for selective control of woody plants and weeds. For terrestrial use only.

OPERATIONAL DETAILS:

TARGET PLANTS: Triclopyr is used to control woody plants and weeds.

MODE OF ACTION: Triclopyr is absorbed by the leaves, bark, and roots, disturbing plant growth.

METHOD OF APPLICATION AND RATES: Aerial (helicopter only) and ground broadcast, spot, and localized applications at 0.2 to 2.5 lbs./acre.

SPECIAL PRECAUTIONS:

TIMING OF APPLICATION: Apply foliar treatment anytime plant is growing. Bark treatments can be applied any time. Dormant stem applications are made when the plant is dormant.

DRIFT CONTROL: Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

RESTRICTIONS/WARNINGS/LIMITATIONS: Do not apply through any type of irrigation system. Non-target plant advisory. Grazing, haying, and slaughter restrictions (see individual labels).

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: The half-life of triclopyr (BEE) and (TEA) is 46 days.

ADSORPTION: The K(oc) of triclopyr (BEE) is 780. The K(oc) of triclopyr (TEA) is 20.

PERSISTENCE AND AGENTS OF DEGRADATION: Triclopyr (BEE) and (TEA) are moderately persistent in the plant and soils. The primary route of degradation is microbial activity.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: Breakdown products are found in very low concentrations and should be relatively non-toxic.

WATER:

SOLUBILITY: Triclopyr (BEE) 23 mg/l in water (pH 7 at 25° C). Triclopyr (TEA) 2,100,000 mg/l in water (pH 7 at 25° C).

POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER: Triclopyr (BEE) has a low potential to leach into groundwater and a moderate potential for surface water runoff. Triclopyr (TEA) has a very high potential to leach into groundwater and a low potential for surface water runoff.

AIR:

VOLATILIZATION: Not determined.

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: Not known.

IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

FOR TRICLOPYR (BEE)

MICROORGANISMS:

ACUTE CONTACT TOXICITY: LD_{50} (honey bee contact) >100 µg/bee

OVERALL TOXICITY: Practically Non-Toxic

PLANTS: Contact will injure or kill target and non-target plants.

AQUATIC VERTEBRATES:

ACUTE TOXICITY: LC_{50} (rainbow trout 96-hour) 0.65 mg/l

ACUTE TOXICITY: LC_{50} (bluegill sunfish 96-hour) 0.36 mg/l

ACUTE TOXICITY: LC_{50} (coho salmon 96-hour) 0.45 mg/l

OVERALL TOXICITY: Highly Toxic

AQUATIC FRESHWATER INVERTEBRATES:

ACUTE TOXICITY: LC_{50} (*Daphnia magna* 48-hour) 1.7 mg/l

OVERALL TOXICITY: Moderately Toxic

AQUATIC ESTUARINE/MARINE INVERTEBRATES:

ACUTE TOXICITY: EC_{50} (grass shrimp 96-hour) 1.7 mg/l

ACUTE TOXICITY: EC_{50} (eastern oyster 96-hour) 0.32 mg/l

ACUTE TOXICITY: EC_{50} (tidewater silverside 96-hour) 0.45 mg/l

OVERALL TOXICITY: Highly Toxic

TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD_{50} (bobwhite quail) 8490 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (bobwhite quail) >5000 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (mallard duck) >5000 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD_{50} (rat) 644 mg/kg

OVERALL TOXICITY: Practically Non-Toxic

BIOACCUMULATION POTENTIAL: Little Potential

THREATENED AND ENDANGERED SPECIES: Federally listed terrestrial and aquatic plants, invertebrates and vertebrates may be adversely affected if the product is applied directly to the plants or animals, or indirectly, as the result of drift or leaching.

FOR TRICLOPYR (TEA)

MICROORGANISMS:

ACUTE CONTACT TOXICITY: LD_{50} (honey bee contact) >100 ug/bee

OVERALL TOXICITY: Practically Non-Toxic

PLANTS: Contact will injure or kill target and non-target plants.

AQUATIC VERTEBRATES:

ACUTE TOXICITY: LC_{50} (rainbow trout 96-hour) 240 mg/l

ACUTE TOXICITY: LC_{50} (bluegill sunfish 96-hour) 471 mg/l

OVERALL TOXICITY: Practically Non-Toxic

AQUATIC FRESHWATER INVERTEBRATES:

ACUTE TOXICITY: LC_{50} (*Daphnia magna* 48-hour) 1496 mg/l

OVERALL TOXICITY: Practically Non-Toxic

AQUATIC ESTUARINE/MARINE INVERTEBRATES:

ACUTE TOXICITY: EC_{50} (grass shrimp 96-hour) 58 mg/l

ACUTE TOXICITY: EC_{50} (fiddler crab 96-hour) >1000 mg/l

ACUTE TOXICITY: EC_{50} (eastern oyster 96-hour) >56 mg/l

OVERALL TOXICITY: Slightly Toxic

TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD_{50} (mallard duck) 2055 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (bobwhite quail) 11,622 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (mallard duck) >10,000 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD_{50} (rat) 644 mg/kg

OVERALL TOXICITY: Slightly Toxic

BIOACCUMULATION POTENTIAL: Little Potential

THREATENED AND ENDANGERED SPECIES: Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

V. TOXICOLOGICAL DATA

FOR TRICLOPYR (BEE)

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD_{50} (rat) 803 mg/kg

ACUTE DERMAL TOXICITY: LD_{50} (rabbit) >2000 mg/kg

PRIMARY SKIN IRRITATION: Rabbit - Non-Irritant

PRIMARY EYE IRRITATION: Rabbit – Slight Irritant

ACUTE INHALATION: LC_{50} (rat) >4.8 mg/l

OVERALL TOXICITY: Category III – Slightly Toxic

CHRONIC TOXICITY:

CARCINOGENICITY: EPA Group D - Not classifiable as a human carcinogen.

DEVELOPMENTAL/REPRODUCTIVE: Positive for adverse developmental and reproductive effects.

MUTAGENICITY: No adverse effects.

HAZARD: The end-use product labels for the triclopyr (BEE) formulations carry the *Caution* signal word due to potential eye, skin, ingestion, and inhalation hazards.

FOR TRICLOPYR (TEA)

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD_{50} (rat) 1847 mg/kg

ACUTE DERMAL TOXICITY: LD_{50} (rabbit) >2000 mg/kg

PRIMARY SKIN IRRITATION: Rabbit - Non-Irritant

PRIMARY EYE IRRITATION: Rabbit – Corrosive

ACUTE INHALATION: LC_{50} (rat) >2.6 mg/l

OVERALL TOXICITY: Category I – Highly Toxic

CHRONIC TOXICITY:

CARCINOGENICITY: EPA Group D - Not classifiable as a human carcinogen.

DEVELOPMENTAL/REPRODUCTIVE: EPA Group D - Not classifiable as a human carcinogen.

MUTAGENICITY: No adverse effects.

HAZARD: The end-use product labels for the triclopyr (TEA) formulations carry the *Danger* signal word due to corrosive potential to the eye.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: Eye irritation and skin irritation.

CHRONIC TOXICITY:

REPORTED EFFECTS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: See effects reported under acute toxicity.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS: None..

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: Triclopyr (TEA) is a severe eye irritant.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: None reported.

VII. SAFETY PRECAUTIONS

SIGNAL WORD AND DEFINITION:

TRICLOPYR (BEE) - **CAUTION** – HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH THE SKIN.

TRICLOPYR (TEA) - **DANGER** – CORROSIVE. CAUSES IRREVERSIBLE EYE DAMAGE. HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH THE SKIN. PROLONGED OR REPEATED CONTACT WITH THIS HERBICIDE MAY CAUSE ALLERGIC SKIN REACTIONS

PROTECTIVE PRECAUTIONS FOR WORKERS: Applicators and other handlers must wear protective eyewear (TEA only), and, long-sleeved shirt and long pants, shoes and socks.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

EYES: Flush eyes with water for 15 minutes. Call physician.

SKIN: Wash all exposed areas with soap and water; call physician if irritation persists.

INGESTION: Call physician. Do not induce vomiting.

INHALATION: Remove to fresh air. Call a physician if breathing difficulty persists.

HANDLING, STORAGE AND DISPOSAL: Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

EMERGENCY SPILL PROCEDURES AND HAZARDS: Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food or feed by storage or disposal.

VIII. DEFINITIONS

adsorption – the process of attaching to a surface

avian – of, or related to, birds

CAEPA – California Environmental Protection Agency

carcinogenicity – ability to cause cancer

CHEMTREC – Chemical Transportation Emergency Center

dermal – of, or related to, the skin

EC_{50} - median effective concentration during a bioassay

ecotoxicological – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

FIFRA – Federal Insecticide, Fungicide and Rodenticide Act

formulation – the form in which the pesticide is supplied by the manufacturer for use

half-life – the time required for half the amount of a substance to be reduced by natural processes

herbicide – a substance used to destroy plants or to slow down their growth

Hg – chemical symbol for mercury

IARC – International Agency for Research on Cancer

K(oc) – the tendency of a chemical to be adsorbed by soil, expressed as: K(oc) = conc. adsorbed/conc. dissolved/% organic carbon in soil

LC_{50} – the concentration in air, water, or food that will kill approximately 50% of the subjects
LD_{50} – the dose that will kill approximately 50% of the subjects
leach – to dissolve out by the action of water
mg/kg – weight ratio expressed as milligrams per kilogram
mg/l – weight-to-liquid ratio expressed as milligrams per liter
microorganisms – living things too small to be seen without a microscope
mPa – milli-Pascal (unit of pressure)
mutagenicity – ability to cause genetic changes
NFPA – National Fire Protection Association
NIOSH - National Institute for Occupational Safety and Health
NOEL - no observable effect level
non-target – animals or plants other than the ones that the pesticide is intended to kill or control
OSHA - Occupational Safety and Health Administration
Pa – Pascal (unit of pressure)
persistence – tendency of a pesticide to remain to remain in the environment after it is applied
pesticides – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA
PPE – personal protective equipment
ppm – weight ratio expressed as parts per million
residual activity – the remaining amount of activity as a pesticide
T&E – Threatened and Endangered Species (from the Endangered Species Act)
µg – micrograms
volatility – the tendency to become a vapor at standard temperatures and pressures

IX. INFORMATION SOURCES

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X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD_{50} (mg/kg)	Acute Dermal LD_{50} (mg/kg)	Acute Inhalation LC_{50} (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	**DANGER (poison)**	0–50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	**WARNING**	>50–500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	**CAUTION**	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	**NONE**	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals Acute Oral LD_{50} mg/kg)	Avian Acute Oral LD_{50} (mg/kg)	Avian Acute Dietary LC_{50} (mg/kg)	Fish or Aquatic Invertebrates Acute Concentration LC_{50} (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

Disclaimers and Other Legal Information:

Mention of a trademark, vendor, technique, or proprietary product does not imply or constitute an endorsement of the product by the United States Department of Energy - Bonneville Power Administration (USDOE-BPA), its employees, and its contractors, and does not imply or endorse any product to the exclusion of others. In all cases, the user is required by law to follow all pesticide label instructions and restrictions.

This fact sheet was prepared by USDOE-Bonneville Power Administration, March 2000.

Trinexapac-ethyl

HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

I. BASIC INFORMATION

COMMON NAME: trinexapac-ethyl

CHEMICAL NAME: 4-(cyclopropyl-a-hydroxymethylene)-3,5-dioxo-cyclohexanecarboxylic acid ethylester

CAS No. 95266-40-3

CHEMICAL TYPE*:* Cyclopropyl Derivative of Cyclohexenone

PESTICIDE CLASSIFICATION*:* Plant Growth Retardant

REGISTERED USE STATUS*:* "General Use."

FORMULATIONS: Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal concern were placed on List 4.

The inert ingredients of the trinexapac-ethyl formulations are not classified by the USEPA as inert ingredients of toxicological concerns to humans or the environment.

The contents of the two trinexapac-ethyl formulations are listed below:

Primo WSB®	Trinexapac-ethyl	25%
	Inert	75%
Primo Liquid®	Trinexapac-ethyl	12%
	Inert	88%

RESIDUE ANALYTICAL METHODS: Information not available.

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES*:* Registered as a growth retardant for grasses.

OPERATIONAL DETAILS:

TARGET PLANTS: Trinexapac-ethyl is used to regulate the growth of many types of grasses.

MODE OF ACTION: Foliar uptake reduces cell growth.

METHOD OF APPLICATION: Low-pressure sprayers at various application rates (see label). Do not apply through any type of irrigation system.

SPECIAL PRECAUTIONS:

TIMING OF APPLICATION: Various (see label), however, as trinexapac-ethyl is a foliar growth retardant, it must be applied to emerged plants to be effective.

DRIFT CONTROL: Trinexapac-ethyl is applied mixed with water/surfactant. Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas.

RESTRICTIONS/WARNINGS/LIMITATIONS: Do not apply through any type of irrigation system. Do not graze area or feed forage after application.

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: Information not available.

ADSORPTION: Information not available.

PERSISTENCE AND AGENTS OF DEGRADATION: Information not available.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: Information not available.

WATER:

SOLUBILITY: 2.11 mg/l at 20° C.

POTENTIAL FOR LEACHING INTO SURFACE AND GROUND WATER: Information not available.

AIR:

VOLATILIZATION: 0.003 Pa at 20° C.

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: Information not available; however, Primo Liquid® is a NFPA Class IIIA combustible liquid.

IV. ECOLOGICAL TOXICITY EFFECTS ON NON-TARGET SPECIES

MICROORGANISMS:

ACUTE CONTACT TOXICITY: LD_{50} (honey bee contact) >100 µg/bee

OVERALL TOXICITY: Practically Non-Toxic

PLANTS: Contact will injure or kill target and non-target plants.

AQUATIC VERTEBRATES:

ACUTE TOXICITY: LC_{50} (rainbow trout 96-hour) 68 mg/l

ACUTE TOXICITY: LC_{50} (bluegill sunfish 96-hour) >130 mg/l

OVERALL TOXICITY: Slightly Toxic

AQUATIC FRESHWATER INVERTEBRATES:

ACUTE TOXICITY: EC_{50} (*Daphnia magna* 48-hour) 142.5 mg/l

OVERALL TOXICITY: Practically Non-Toxic

AQUATIC ESTUARINE/MARINE INVERTEBRATES:

ACUTE TOXICITY: EC_{50} (grass shrimp 96-hour) No information.

ACUTE TOXICITY: EC_{50} (eastern oyster 96-hour) No information.

OVERALL TOXICITY:

TERRESTRIAL ANIMALS:

AVIAN ACUTE ORAL TOXICITY: LD_{50} (mallard duck) >2000 mg/kg

AVIAN ACUTE ORAL TOXICITY: LD_{50} (bobwhite quail) >2250 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (bobwhite quail) >5620 mg/kg

AVIAN SUBACUTE DIETARY TOXICITY: LC_{50} (mallard duck) >5200 mg/kg

MAMMAL ACUTE ORAL TOXICITY: LD_{50} (rat) >5000 mg/kg

OVERALL TOXICITY: Practically Non-Toxic

BIOACCUMULATION POTENTIAL: Little Potential

THREATENED AND ENDANGERED SPECIES: Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

V. TOXICOLOGICAL DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD_{50} (rat) >5050 mg/kg

ACUTE DERMAL TOXICITY: LD_{50} (rabbit) >2020 mg/kg

PRIMARY IRRITATION SCORE: Slight

PRIMARY EYE IRRITATION: Moderate

ACUTE INHALATION: LC_{50} (rat) >2.7 mg/l

OVERALL TOXICITY: Category III – Caution – Slightly Toxic (dry formulations)

OVERALL TOXICITY: Category II – Warning – Moderately Toxic (liquid formulations)

CHRONIC TOXICITY:

CARCINOGENICITY: Increase in stomach tumors in male mice at 2000-ppm dose rate.

DEVELOPMENTAL: None observed.

REPRODUCTIVE: None observed.

MUTAGENICITY: None observed.

HAZARD: Based on the results of animal studies, trinexapac-ethyl may cause an increase in carcinogenicity. Tests on dogs show liver, kidney and brain effects (unspecified) at >5000 ppm doses.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: None reported.

CHRONIC TOXICITY:

REPORTED EFFECTS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS: Slight eye irritation caused by clay binding agents.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: There have been no reported effects on workers manufacturing the products.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: None reported.

HEALTH RISK MANAGEMENT PROCEDURES: See Section VII.

VII. SAFETY PRECAUTIONS

SIGNAL WORD AND DEFINITION:

Dry formulations

TRINEXAPAC-ETHYL - **CAUTION** – HARMFUL IF ABSORBED THROUGH THE SKIN OR INHALED. CAUSES MODERATE EYE IRRITATION. AVOID CONTACT WITH EYES, SKIN OR CLOTHING AND BREATHING DUST OR SPRAY MIST.

Liquid formulations

TRINEXAPAC-ETHYL - **WARNING** – CAUSES EYE IRRITATION. DO NOT GET IN EYES. HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN. AVOID CONTACT WITH SKIN OR CLOTHING. AVOID BREATHING VAPOR OR SPRAY MIST.

PROTECTIVE PRECAUTIONS FOR WORKERS: Use safety glasses. Use impervious gloves when prolonged or frequently repeated contact could occur. In enclosed spaces, use NIOSH-approved dust respirator. Long sleeve shirt, long pants, shoes and socks are recommended. Do not enter treated areas without shoes until sprays have dried.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

EYES: Flush eyes with water; call physician if irritation develops.

SKIN: Wash all exposed areas with soap and water. Wash all contaminated clothing prior to reuse. Call a physician if irritation develops.

INGESTION: Give large quantity of water and induce vomiting. Call a physician or Poison Control Center. Administer activated charcoal (6-8 teaspoons) with a large amount of water. Immediately transport to a medical care facility.

INHALATION: Move to fresh air. Provide artificial respiration if necessary. Call physician if breathing difficulty continues.

HANDLING, STORAGE AND DISPOSAL: Keep dry and store away from food, feed or other material to be used or consumed by humans or animals. Do not contaminate water. Dispose of only in accordance with local, state and federal regulations. Primo Liquid® is a NFPA Class IIIA combustible liquid.

EMERGENCY SPILL PROCEDURES AND HAZARDS: Contain and sweep up material of small spills and dispose as waste. Large spills should be reported to CHEMTREC (800-424-9300) for assistance. Prevent runoff. Do not contaminate water, food or feed by storage or disposal.

VIII. DEFINITIONS

adsorption – the process of attaching to a surface

avian – of, or related to, birds

CAEPA – California Environmental Protection Agency

carcinogenicity – ability to cause cancer

CHEMTREC – Chemical Transportation Emergency Center

dermal – of, or related to, the skin

EC_{50} - median effective concentration during a bioassay

ecotoxicological – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

FIFRA – Federal Insecticide, Fungicide and Rodenticide Act

formulation – the form in which the pesticide is supplied by the manufacturer for use

half-life – the time required for half the amount of a substance to be reduced by natural processes

herbicide – a substance used to destroy plants or to slow down their growth

Hg – chemical symbol for mercury

IARC – International Agency for Research on Cancer

K(oc) – the tendency of a chemical to be adsorbed by soil, expressed as: K(oc) = conc. adsorbed/conc. dissolved/% organic carbon in soil

LC_{50} – the concentration in air, water, or food that will kill approximately 50% of the subjects

LD_{50} – the dose that will kill approximately 50% of the subjects

leach – to dissolve out by the action of water

mg/kg – weight ratio expressed as milligrams per kilogram

mg/l – weight-to-liquid ratio expressed as milligrams per liter

microorganisms – living things too small to be seen without a microscope

mPa – milli-Pascal (unit of pressure)

mutagenicity – ability to cause genetic changes

NFPA – National Fire Protection Association

NIOSH - National Institute for Occupational Safety and Health

NOEL - no observable effect level

non-target – animals or plants other than the ones that the pesticide is intended to kill or control

OSHA - Occupational Safety and Health Administration

Pa – Pascal (unit of pressure)

persistence – tendency of a pesticide to remain to remain in the environment after it is applied

pesticides – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

PPE – personal protective equipment

ppm – weight ratio expressed as parts per million

residual activity – the remaining amount of activity as a pesticide

T&E – Threatened and Endangered Species (from the Endangered Species Act)

µg – micrograms

volatility – the tendency to become a vapor at standard temperatures and pressures

IX. INFORMATION SOURCES

EPRI, Determination of the Effectiveness of Herbicide Buffer Zones in Protecting Water Quality, EPRI Final Report TR-113160, 1999

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X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD_{50} (mg/kg)	Acute Dermal LD_{50} (mg/kg)	Acute Inhalation LC_{50} (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	**DANGER (poison)**	0–50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	**WARNING**	>50–500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	**CAUTION**	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	**NONE**	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals (Acute Oral LD_{50} mg/kg)	Avian (Acute Oral LD_{50} mg/kg)	Avian LC_{50} (mg/kg)	Fish or Aquatic Invertebrates LC_{50} (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

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